

GOVERNMENT OF INDIA
DEPARTMENT OF INDUSTRIES AND SUPPLIES



REPORT
of the
Industrial Plant and Machinery
(Heavy) Panel.



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REPORT OF THE INDUSTRIAL PLANT & MACHINERY (HEAVY) PANEL

CHAPTER—I

GENERAL INTRODUCTORY REMARKS.

Note.—In this chapter the Panel reviews broadly certain general factors which arise in investigating the possibility of establishing an Industrial Plant and Machinery (Heavy) Industry in India.

1. Introduction.

The Panel for the Industrial Plant and Machinery (Heavy) industry was constituted by the Planning and Development Department of the Government of India in April 1945, for the purpose of investigating and considering the question of establishment and development of the manufacture of Industrial Plant and Machinery in India.

The General Directive to Industrial Panels set up by the Planning and Development Department, (vide Appendix I hereto) constituted the terms of reference to the panel. Members of the Panel are as follows:—

Mr. G. L. Mehta, M.A.,	Chairman,
Sir Dhanjishah B. Cooper, Kt.,	Member.
Brig. M. H. Cox, M.I. Mech. E.,	"
Mr. S. L. Kirloskar, B.Sc. (America), Member A.S.M.E.,	"
Mr. P. F. S. Warren, M.A. (Cantab), A.M.I.C.E., A.M.I.E. (India)	"
Mr. S. Moolgaoker, B.Sc. (Hons), London	"
Mr. K. K. Birla,	"
Mr. L. J. Barracrough, M.Sc., M.I. Min. E.M.I. (American), Min. E.	"
Mr. C. S. N. Raju, B.A., M.Sc. (Mech. E.)	Secretary.

Although the Panel was constituted in April 1945, the Secretary was not appointed until July 1945, consequently the work of the Panel could not be commenced effectively until August/September 1945.

Panel meetings were held at Calcutta, at New Delhi and at Bombay; in all six meetings were held, Mr. H. V. Coes, Vice-President of Messrs. Ford, Bacon and Davis Inc., New York, U.S.A, who visited India at the special request of the Government of India, in order to advise on the scope and development of engineering industries in India, attended the second meeting held in Delhi on the 14th January 1946. The members of the Panel had the opportunity of discussing several problems with him at that meeting.*

* Reference is also invited to the Report on the Manufacture of Industrial Machinery and Equipment in India, submitted by Messrs. Ford, Bacon and Davis Inc., U.S.A.

The Panel members visited the following works:—

- (i) The Ordnance Factory at Cossipore (Calcutta)
- (ii) The Ordnance Factory at Ischapur (Calcutta)
- (iii) Messrs. Jessop & Co.'s Works (Calcutta)
- (iv) The Ordnance Factory at Ambernath (near Bombay)

The Panel had originally intended to visit more factories, particularly Heavy Engineering Works, but since the secretary of the Panel, Mr. Raju, visited most of the important engineering works in India with Mr. Coes and was able to place such information as he collected during his tour at the disposal of the Panel, and since the members of the Panel had a good general knowledge of the scope and the products of the various engineering works in the areas from which they came, it was not considered necessary to visit further centres. Besides, the time factor and difficulties of travelling precluded an elaborate programme of visits to factories by the full Panel.

2. Scope of Panel.

(i) The plant and machinery manufacturing industry under consideration by this Panel covers a wide potential field of development, since the industry, when fully established, should be capable of supplying the major portion of the plant and machinery requirements of the country, within the field defined in para 3 below.

Several of the Panels appointed by the Planning and Development Department have been able to obtain up-to-date factual information for use in the preparation of their Report. Furthermore, in most cases they were furnished, by Government, with provisional targets, *vide* para 3 of General Directive (Appendix I hereto). In the case of this Panel, however, practically no factual data was available, as there is hardly any heavy machinery manufacturing industry in existence in the country. As regards provisional targets for this Panel, owing to the wide range of products in the field covered by the work of the Panel, Government could not give the Panel a provisional target. Since, however, some form of target is essential in considering the development of any industry, the necessary data in regard to this industry has been built upon the basis of such reports and recommendations of other Panels as became available, and from the somewhat meagre information available regarding pre-war imports. Owing to this lack of basic information the Panel has been unable to do more than express targets in rupee values, instead of coupling this form of expression with information regarding numbers and types of machines. The Panel, appreciating the inadequacy, from the manufacturing point of view, of targets expressed in money values only and the unreliability of this method of expression over a long period, owing to changing money values, cannot stress too strongly the need for setting up a Statistical Bureau, *vide* para 7 (f) below, one of the responsibilities of which will be to furnish more adequate information regarding imports, particularly numbers and types of various items which is of vital importance to manufacturers in planning a forward programme for the manufacture of such equipment in India.

(ii) The development of a machinery manufacturing industry is also bound up with the question of general industrial development and particularly with the growth of specific industries which have

already been more or less firmly established but which have potentialities of further expansion in the near future. The manufacture of machinery must, therefore, keep pace with the establishment, on a large scale, of the industries for which machinery is to be used. For instance, nearly one-third of India's requirements in capital goods has hitherto been in the form of textile machinery and since this industry has possibilities of further development in several directions, it will require machinery not only for replacement and rehabilitation, but also for expansion. There are many other industries which will require machinery mainly for replacement and spare parts in the near future. These questions have been considered in detail in the subsequent chapters of this Report, on the basis of such statistics and data as are available, but as pointed out above, the information available is so inadequate that the problem has been dealt with in its broad aspects only.

(iii) It is also not easy to define precisely the scope of the Panel due to lack of an exact definition of the term "Heavy Plant and Machinery." There are separate Panels for the following industries which are very closely connected with the heavy plant and machinery manufacturing industry:—

- (i) Machine Tools
- (ii) Light Engineering Industries
- (iii) Electrical Machinery & Equipment
- (iv) Automobiles and Tractors
- (v) Prime Movers.

There is also a sub-Panel for dealing with the question of manufacture of Road Rollers. No report of this sub-Panel has, however, been received by this Panel.

It is, therefore, obvious, that some overlapping in respect of these Panels and the Heavy Plant and Machinery Panel is unavoidable. The Department of the Government concerned will, no doubt, co-ordinate the recommendations of the various Panels in evolving a comprehensive plan.

Appendix II hereto is a list of the important heavy industries which come within the scope of this Panel. Certain industries, important in themselves, but which have not yet attained great importance in the Indian market, are not included in the list.

3. Classification.

Industrial Plant & Machinery (Heavy) may be defined as such plant, equipment and machinery as is required by and utilised in different industries for the manufacture of their end products, and which can be broadly defined as heavy, either on account of its weight or bulk, or the complex technique employed in its manufacture.

4. Questionnaire:

A questionnaire prepared by this Panel was addressed to some 60 concerns, including Chambers of Commerce and Trade Associations, as well as firms interested in the manufacture or utilisation of machinery. Copies were also forwarded to Provincial/State Governments. The response has, unfortunately, not been satisfactory and, despite reminders, only 27 replies were received. Very few of the Provincial/State Governments sent replies or offered comments.

Even where replies were received, the information furnished, with a few exceptions, was meagre and inadequate.

5. **Basis of Report.**

For the purpose of this Report it was considered essential that the present demand for industrial plant and machinery should first be ascertained and tabulated as closely as possible, together with a forecast of the possible development of various industries, in order to arrive at the target demand of the first five-year period. In the absence of a target, recourse has been made to statistics of per-war demands to estimate the anticipated five-year target demands. The target estimates given in the report should, therefore, be regarded as approximate only. It is desirable that Government should when considering the implementation of the report of this Panel, secure the services of first-rate consulting engineers and industrial planning experts, to work out plans and lay-outs and to determine specific and technical lines of development of the industry.

6. **Need for an Industrial Plant (Heavy) Machinery Manufacturing Industry:**

It is hardly necessary to emphasise the vital importance of this industry, which is fundamental to industrial development of the country. The pace and scope of industrialisation in India during World War II was definitely restricted owing to the absence of a heavy machinery industry and a well-developed machine tool industry. It is sometimes argued that these industries can only be developed at an advanced stage of industrial progress and that our immediate need is for building up only consumer goods industries. While it is no doubt true that such industries as the heavy machinery industry and machine tool industry must be planned according to the pace of industrial development, there is no reason to postpone the development of these industries until the country becomes completely industrialised in regard to the production of consumer goods. In several other countries such as Soviet Russia and even comparatively undeveloped countries like Brazil, care has been taken to establish the manufacture of machinery for certain industries concurrently with the development of such industries, so that the products of the former can readily be absorbed by the latter and basic industries built up along with secondary industries. In the Soviet Plans, for example, great emphasis was laid, from the first, upon the development of reproductive industry. Production of the "means of production" was over 60% of the total industrial output immediately before the outbreak of World War II. This was twelve times larger than it was during World War I. By 1941, machine making accounted for about 25% of all Soviet production. In the post-war period, it has been made clear that the manufacture of "machines to make machines" will have high priority in Soviet Russia. The absence of a machinery manufacturing industry in India is being felt keenly in the post-war period. Import of capital goods from U.K. or U.S.A. has been rendered difficult owing to several reasons, such as exchange restrictions, shortage of shipping and, above all, the pre-occupation of the countries themselves with their own programmes of rehabilitation and replacement. There is no principle of "equal access to the capital goods of the world", complementary to the principle embodied in the Atlantic Charter of "equal access to the raw materials of the world". While prices of raw materials for international markets are still, in many cases, controlled and even their

export canalised, there is no corresponding check or control on capital goods. Capital goods are indispensable for industrial development and their present dearth is a strong reason why the possibilities of manufacture of such goods within the country should be investigated without delay. For, we should not, in future, be so completely dependent on outside sources for our capital goods.

It is true, no doubt, that industrialists in India have become largely accustomed to the use of imported machinery and it may take time before they become accustomed to the idea of purchasing indigenous machinery; especially because, in capital goods, durability and precision are far more important than in consumer goods. Nor is it deniable that the machinery manufacturing industry would suffer in the initial stages from several difficulties and handicap which are dealt with later in this Report. To minimise these difficulties we must first select for manufacture machinery for such industries as have already been established on a large scale and in which the machinery, although in some cases involving a series of machines, is on the whole fairly simple. The textile industry is a case in point where there is considerable field for immediate development. We feel, most strongly that a beginning has to be made and that, too, without delay. We cannot visualise an all-round development of India without the establishment and steady growth of machinery manufacture within the country.

7. Problems of machinery manufacture.

Although several technical factors relating to the establishment of this industry are considered in detail in the subsequent chapters of this Report, we deal here with some of the broad aspects of the problem of machinery manufacture, including the difficulties which would be encountered in the early stages of development. In this respect the experience, during the war, of the indigenous engineering industry in general, and the machine tool industry in particular, is relevant and helpful. Machine tools may, indeed, be classified in a sense as industrial plant and machinery, while in another sense they are basic to the manufacture of industrial plant and machinery itself.

(a) Design.

A factor of first importance, and one which is intimately bound up with the question of quality is that of design. It is essential that machines to be produced in India should be of the latest design as far as is possible, since under present-day conditions, where rapid technological development and keen competition in world markets render necessary the highest possible efficiency, it would not be possible for machinery based on obsolete and discarded designs to survive. It is doubtful, however, whether India could, at present, expect to produce original designs and we shall have to depend, at any rate for sometime to come, upon assistance from other countries. The advice and help of foreign consultants and experts will therefore have to be taken. This raises in turn the whole question of patents and licenses and necessitates some form of collaboration and co-ordination with foreign manufacturers of machinery. We feel that initially such technical collaboration will be essential, since changes in designs, specifications and technical improvements are very rapid. The terms and conditions on which such co-operation can be obtained is a matter for consideration by Government in consultation with the industrialists and manu-

facturers concerned. But we are strongly of the opinion that, in all such arrangements and agreements, the controlling interests and effective management should be in the hands of Indians. It would for example, be necessary to obtain the use of patents by licenses and payment of royalties. Technical assistance also should be obtained on terms which would safeguard the national character of the organisation.

(b) Design of Plants and Fabrication of Pilot Plants.

While on the subject of designing, we would suggest for the consideration of Government the desirability of subsidizing or otherwise assisting the design of industrial plants and the fabrication of pilot plants. Even in highly industrialised countries, it is common experience that work done in a research laboratory has not been readily translated into commercial practice, even though such research work has promised good results. This has been due mainly to lack of resources needed for erecting large scale plants to demonstrate the value of a discovery. Again, research may reach the stage when it needs relatively large-scale trials before commercial developments can be considered. Applied research, in other words, leads to practical results of commercial value only after passing through an intermediate developmental process. This process is expensive and at the present stage of India's industrial development, it may in some cases be too much to expect that private enterprise will, from its own resources, be able to render such services in an efficient manner. The State will have to assist industry if we are to remove the complete dependence on other countries for supply of Industrial plants in Russia for example institute were set up for design and fabrication of Industrial plant in the early stages of the operations of their economic plans, where specialists in mechanical, electrical, metallurgical, fuel chemical textile and other branches of engineering worked as a team and drew up plans of various known industrial processes, prepared working designs and undertook fabrication of the entire plant for the exploitation of such processes. Such a Plan is practicable only in a highly socialised state, where industry is largely, if not entirely, under state control and direction. In India more reliance must be placed on private enterprise. The question, however, of initially assisting private enterprise in the design of industrial plants and the fabrication of pilot plants, must be kept prominently to the fore, otherwise there will be a gap between applied research and commercial development of the results of such research.

(c) Quality.

Coupled with the use of modern designs, Indian machinery manufacturers will have to concentrate their attention on the question of quality, which is of the greatest importance in machinery manufacture. The machinery to be produced must, from the very beginning, be of the best possible quality, comparable in efficiency with the best available plant and equipment from foreign countries. This involves not only efficient organisation and adequate resources, but also enterprise and vision in the larger interests of the country. It would be best if manufacturers develop, in the beginning, a few simple but modern types of machines of the best quality and extend to more complex types as experience is gained. The ultimate aim should be to produce, in addition to simple machines, such semi-automatic and automatic machinery as can be worked efficiently by reasonably intelligent

but unskilled labour, rather than to produce only such machinery as requires highly trained and skilled labour for its operations. In this way India's limited resources of skilled labour can be used to the best advantage, in building machines, rather than operating them. It would also be beneficial to the growth of machinery manufacture if there is specialisation by firms in the production of specific types rather than that every large firm should plan to manufacture a wide variety of types, each manufacture in competition with the others.

The quality of the machinery will depend upon several factors, including availability of good quality raw materials, experienced technicians and supervisors, skilled labour, rigid inspection as well as efficient works organisation.

Industrial machinery, like machine tools, requires sound and scientifically made iron castings with requisite physical properties, as a basis of construction, and therefore the production of these high quality castings is a question to which engineering firms in the country will have to apply themselves. Castings have not only to be manufactured from a proper grade of iron possessing the necessary physical and chemical properties but also in many cases require to be adequately seasoned in order to prevent warping. Unless proper seasoning is given where necessary, difficulties may occur at later stages in manufacture and during service, due to warping of castings. In many cases the quality of indigenous engineering products suffers on account of inferior iron castings.

Even such firms as were able to produce casting of the desired quality found serious difficulties owing to the poor quality of other raw materials which they were compelled to utilise, owing to non-availability of materials of the requisite quality and standard. Apart from the normal run of raw materials, the manufacture of certain machinery will require special kinds of steel such as high grade and alloy steels and metals which resist corrosion and withstand high temperature. Even though indigenous steel producing firms were manufacturing alloy steels, medium carbon and high carbon steels during the war period, the output of such firms during the war was almost fully taken up for munitions production, with the result that such steel were not readily available for use by other industries. It is therefore necessary that high quality steels, for building into industrial plant and machinery according to type, should be available to manufacturers, and that the plant should be available for processing to the required standards and for heat treatment where necessary. Particular attention will also have to be paid to the production of steel castings of high quality and various grades.

In connection with the foregoing we cannot emphasise too strongly the vital importance of evolving and maintaining specifications and standards for materials to be used for the manufacture of machinery. Our detailed recommendations on this point are made in subsequent chapters of this Report.

(d) *Technical Personnel:*

The training of technical personnel is of great importance to this industry. The experience gained in the manufacture of machine tools during the war period, as well as in Ordnance Factories, should prove valuable in starting and running plants for the manufacture of machinery. But there is no denying the fact that there is a serious dearth of qualified and experienced technicians, especially for the heavy

engineering industries and this shortage needs to be made good as speedily as possible.

We trust that the scheme which has been prepared and submitted to Government by the Committee for the Development of Higher Technical Institutions in India like the M.I.T. in U.S.A., and which has been approved by the Government will be implemented immediately and that adequate facilities will be made available for such training within the country. Special arrangements should also be made for training young men abroad, in both the theory and practice of manufacture of machinery and this subject should be included among these for which students are being sent abroad for technical training under the scheme evolved by the Planning and Development Department. Furthermore, when orders are placed abroad for industrial plants by Government and semi-public authorities such as Port Trust etc., arrangements should be made for the training of Indians in the works of the suppliers of the plants. We understand that this procedure is being followed in regard to the Fertiliser plant, which is being set up in Sindri. Again, whenever Government set up their own plants, whether it be for aircraft manufacture or for hydro-electric projects or anything else, they should arrange that as much as possible of the plants should be manufactured within the country, if necessary with the aid of technicians provided by the suppliers of the plants. Other industrial countries, at the inception of their industrial development, had similar difficulties in regard to training technical personnel as India has at present, and there is, therefore, no need to be defeatist in his respect. The example of Russia might be cited in this connection. Whenever Soviet Russia ordered a plant from any foreign country, the Soviet Government insisted on the suppliers arranging to manufacture most, if not the whole of it, in Russia itself, using to the fullest possible extent Russian raw materials, equipment and labour. They were prepared to pay for the instalment of the plant necessary for manufacture and also for the payment of such license fees as were necessary to continue to use the plant in the future. We have, of course, to adopt this method to our own resources and needs.

(e) *Artisan labour :*

It is also essential that special efforts are made to train labour in tasks which require a high degree of skill. Schemes of technical training, started by Government during war for special purposes, should be adapted to postwar industrial purposes, in close consultation with the interests concerned.

(f) *Statistics :*

We have already mentioned in this Report the absence of statistical materials and data and drawn attention to the need for a proper Bureau of Statistics, to collect and collate data in regard to imports and production, and to ensure that such information is published promptly and periodically.

(g) *Standards, inspection and test :*

The need for establishing proper standards for all stages, from production of raw materials to finished products, as also the application of such standards by adequate inspection and test, cannot be too strongly emphasised. Interchangeability of parts to

appropriate limits is also imperative in the machinery industry, and this demands an efficient and continuous inspection system. Special efforts will have to be made to train inspectors who must possess up-to-date knowledge and experience of machine shop erection and test methods. We need hardly state that unless engineering works, undertaking the manufacture of industrial plant and machinery, are equipped with machines of modern design, capable of production at a satisfactory rate and turning out products of high quality, and also possess the equipment necessary to control manufacture such as high precision measuring and testing equipment, manufacturers will find it difficult to sell their machines on a competitive basis. The Panel welcomes in this connection the establishment of the Indian standards Institution and trust that it will lead to the evolution of proper standards for various types of machinery.

8. State Aid.

These are several directions in which State aid can be accorded to facilitate the establishment of a Heavy Plant and Machinery industry amongst which we would mention the following :

(a) *Licensing :*

The industry for the manufacture of heavy machinery and industrial plant is, strictly speaking, yet to be established in the country. For the establishment of this industry on sound lines such as will render it capable of manufacturing the various items of the latest types of machinery, of a quality comparable to foreign products, it is not only necessary to plan the industry on scientific lines, but also to render active Government assistance so as to secure the Indian market to the industry. Since the products of this industry will be utilised by other industries, it may not be feasible or desirable to give protection to this type of industry through the methods of tariffs, which would inflate the cost of production in other industries. Consumer goods industries to day urge the removal of controls on imports of capital goods and abolition of even revenue duty or at the most the imposition of only a small duty on capital goods and machinery. It may, therefore, be necessary to find other means of fostering this industry such as, as examples, subsidies, preference in purchases, technical aid, transport facilities etc. We believe, however, that for the growth of this industry some form of licensing for import and manufacture, such as has been in operation in respect of machine tools and electric motors, would be the most suitable procedure to adopt. We feel that, with the development of this industry, only such machinery and plant should be allowed to be imported into India as is not manufactured within the country, provided, of course, that indigenous machines are, available in adequate quantities, are of an approved quality and built to an approved specification. For the operation of this system of licensing, it would be necessary to set up machinery such as a Board of Control, to be drawn from representatives of principal industries who are producers of consumer goods, aided by consulting engineers and experts to work out a detailed scheme of priorities and standardisation certificates, as well as to check the quality of products and maintain co-ordination between the machinery manufacturers and various industries using machinery. This will have to be a permanent body not an *ad hoc* body. It is obvious that the scheme will have to be operated in consultation with other industrial interests, (i.e., users

of machinery) and the price factor will be a very important one along with the factor of quality. We favour a system of licensing of imports as the best possible method under present conditions for gradually developing this industry on sound lines while simultaneously ensuring to it an adequate and growing market.

(b) Acquisition of Land and Installation of Common Facilities Necessary for Industrial Development.

The acquisition of land for industrial purposes is generally speaking a lengthy and laborious process. In many cases the claims of the cultivator take precedence over plans for industrial development which may, in the long run bring untold benefits to the country and which will far outweigh the loss of a negligible amount of cultivation.

To facilitate the industrial development of the country as a whole, Provincial and State Governments should be urged by the Central Government to set aside areas of land for industrial undertakings and to make arrangements to resettle cultivators elsewhere, so as to leave the land clear for the establishment of factories the areas selected for industrial development should be reasonably close to main railway lines, and special facilities should be accorded to industrialists for the construction of branch lines and sidings. As a further measure of development, Provincial/State Governments should be urged to instal communications and public utility facilities such as roads, telegraph and telephone lines, water mains, power mains, sewers and sewage disposal installations. All these services should be made available at reasonably cheap rates. Plots of land, opened up for industrial development in this way, should be made available to industrialists at cheap rates, furthermore, industrialists should be permitted to purchase land likely to be required for a reasonable programme of expansion.

Similarly land adjacent to industrial areas should be set aside for the development of housing estates and town planning, if only on paper, should be carried out in advance, to guard against slum development and to provide for common necessities and amenities such as schools, markets, hospitals, places of worship, recreational facilities etc., etc.

(c) Acceleration of depreciation.

The customary rates of depreciation allowed on industrial plant and buildings is considered to be a serious handicap to the modernization of existing works and the establishment of new industries. State aid could, in this matter, take the form of accelerating depreciations for the purpose of taxation relief, at rates which would provide for writing off plant and buildings in say 10 to 16 years according to types.

(d) Supply of raw materials.

In order to compete with foreign manufacturers it is essential that raw materials, particularly imported raw materials, should be made available to Indian industrialists at rates which do not exceed the rates for supplies to foreign industrialists. A study of trade journal shows that in this country this is far from being the case. Basic prices for supply to Indian industrialists are high and these rates are even further enhanced by import duties. The effect of import duties on raw materials in relation to the cost of finished products

is particularly heavy where much of the raw material is cut to waste in processing, for example, in the manufacture of twist drills, cutters, etc., where waste may be as high as 50%. This is a matter which merits the close consideration of Government.



CHAPTER II

STATISTICAL ANALYSIS

*Note:—*In this Chapter the Panel reviews the available statistics with the object of indicating as far as possible, the future demand for Industrial Plant and Machinery (Heavy.)

10. General Considerations.

Different categories of demand for industrial plant and machinery (heavy) have to be ascertained in order to arrive at a proper understanding of the requirements of the country, as well as to determine the future possibilities of manufacture of such machinery and plant within the country. Since, for all practical purposes, there is no organised manufacture of industrial plant and machinery in the country, the values of imported machinery can be taken as an indication of what machinery has been and is being used, as well as a guide to what machinery can be taken up for manufacture. The demand for machinery can be divided broadly into (i) present Demand; (ii) pent-up Demand during the war period of six years; (iii) total Demand for new plants and machinery that will be required for the first five years of development and (iv) the sustained annual Demand including the possible demand for exports, at the end of this five-year period and immediately thereafter. This last category of demand is the principal factor which will determine the scale of manufacture of industrial plant and machinery in the country.

Unfortunately, there is almost a complete lack of statistical information wherefrom these various demands can be worked out. The import figures given in the publications on Sea-borne Trade are the only available sources of information; these figures however can be taken to be a fair indication of the country's demands in the past and as a basis for planning in the future. The six years of war have naturally had disturbing effects on imports and the effects are not yet over, even with the termination of war. Since during the period of the war the law of supply and demand was hardly operative, recourse has to be had to a pre-war period, i.e., the period prior to the year 1940, when market conditions were more or less stable, in order to determine the relative demand. This reversion to the pre-war period means, however, that the conclusions drawn from such demand cannot be accepted as indicating present and future targets without considerable qualifications.

There are, moreover, serious limitations in the data available. The data given are in respect of a few major industries only and several of these major industries are grouped together in a single category designated as "Unclassified Mill Work". Further, all such data is given in money values, with no mention of either quantities or of categories of plant, equipment and machinery imported. Besides, the value of plant and machinery is a variable factor, and if such value is to be shown on any comparable basis, it is necessary to know the annual cost index figures each year for each particular type of plant and machinery. No such cost index figures are available.

A clear picture in its proper perspective is therefore not possible with the available data and certain assumptions have to be made and

necessary correctives applied to the values of imports in order to place them on a comparable basis. It is however generally accepted that the cost of machinery bears a direct relationship with the cost of materials of construction. Iron and steel being the basic materials of construction of most industrial plant and machinery it follows that the variations in the annual cost index figures of iron and steel published by the Board of Trade in the U.K. should give some indication of the variations in costs of machinery. Index values for the year 1935-36 have been given as 100 by the Board of Trade and consequently that year has been taken in this Report as the standard year for comparison. All the values given in the Report are first determined on that basis. To convert the index values so given to 1944-45 values, (the latest index figures available from the Board of Trade) it is necessary to multiply 1935-36 figures by 1.32.

11. Present Demand.

This demand is the basis for arriving at the anticipated sustained annual demand on implementation of the first five years stage of the main development plan. As explained already, owing to the disturbing effects of the war on the imports of industrial plant and machinery, it is not possible to work out this demand with any degree of accuracy. Recourse has therefore to be made to the pre-war years (i.e., years prior to 1940) when market conditions were more stable and normal. Tables 1-A to 1-D give the values of imported industrial plant and machinery (i) as given in the Sea-born Trade Publications and (ii) as corrected for purpose of comparison with reference to the year 1935-36. It is also probable that the averages for several years are more representative of this demand than the values of imports for any particular year. The averages of the corrected values of imports for the five years 1935-36 to 1939-40 are therefore taken to be fairly representative of the pre-war demands.

12. War Period Pent-up Demand.

In order to ascertain this demand, the corrected values of imports have been worked out for the years 1935 to 1945 and an average trend curve drawn. Assuming the pre-war average normal demand to be the average normal demand during the war period as well, and integrating the deficit area for the years 1940-45 this pent-up war demand was determined. This pent-up demand is of particular importance for the planning of manufacture of industrial plant and machinery during the next five years. These values are given separately at the end of this Chapter. If normal imports could be restored within the next year or two, it might be possible for all this pent-up demand to be satisfied within the next five years. This pent-up demand, it should be noted, is one that is over and above the normal annual demand for replacements and improvements etc.

13. Demand for Plant and Machinery for new Projects.

For the industrial development of the country, several industrial panels have envisaged certain targets of development during the next five year period. In most cases, estimates are given of the plant and machinery that would be required for the development thus envisaged during the next five years. These demand

values as far as available, are given at the end of this Chapter in para 16.

14. Anticipated Demand five years hence.

At the present stage of industrial development in India, it is difficult to forecast the probable demand five years hence, particularly owing to several uncertain factors, present and prospective. Future development depends, to a large extent, on India being able to obtain from abroad the required quantities and types of capital goods, technical aid, as well as upon the availability of skilled labour and the prevalence of satisfactory industrial relations within the country. It also depends on the general programme of industrialisation and the adoption of an active policy along with efficient machinery of execution and co-ordination and, to no small measure, on the trend of political developments.

Attempts have, however, been made to determine this demand in more than one way. The simplest approach is probably arithmetical calculation on the basis of a rise in percentage of productive capacity during the next five years, as envisaged by the different Industrial Panels. Another method is through the projection of the trend curves already referred to, on to the year 1950-51. In certain cases, however, where the Panels have not recommended definite targets, or where the trend curves have failed to suggest such probable demands, artificial targets have had to be assumed. As many as 25 trend curves have been drawn. This method had to be adopted in the first place because, in the absence of any Panel Reports, there was no other way of determining the probable demand. As other independent estimates became available, it was found possible to make a comparison between the two types of estimates, and it was found that in many cases there is close proximity and striking similarity between these two kinds of estimates that have been independently worked out. The anticipated sustained demands for the various industries on implementation of the first five year stage of the development plan are mentioned in the following pages and a summary of such demands will be found at the end of this Chapter (vide para 15). Rough estimates of demands for certain industries are given in the following sub-paras.

(a) *Mining Machinery.*

The mining industry, being the source of raw materials for most heavy industries, occupies a pivotal position in post-war planning. The coal required for thermal power stations, the ores and coal required in the metallurgical industries, the minerals and rock products required in the chemical and ceramic industries and the civil engineering industries, have all to be quarried or mined.

The practice hitherto has been for the major portion of mining to be done manually with a limited use of machinery. This had been possible in the past because of the labour available at the then low scales of wages. But the tendency of late, has, for several reasons, been towards increasing mechanisation, the most important of these reasons being the shortage of mine labour at the rates of wages so long prevalent in the industry and the increasing reluctance of labour to undertake such arduous and under ground work.

The pre-war average demand, mostly restricted to replacements and improvements in the existing equipment is valued at Rs. 40 lakhs at 1935-36 prices.

The Iron and Steel (Major) Panel has envisaged a development of that industry within the next five years at about 100% over the present capacity. The Nonferrous Metal Industries Panel has proposed more than 100% development of the industry for copper base alloys and 600% development for aluminium. The Indian Coal Fields' Committee visualise that on the basis of industrial plans made or under contemplation, coal consumption is likely to increase to 39 million tons per annum by 1956 as against the present estimated demand for 30 million tons per annum and recommend that it is necessary to step up production to 42 million tons per annum by that year as against the estimated existing production of 26 million tons per annum. From the general trend of expansion proposed in respect of several important industries, to the extent of 50% to 100%, a corresponding extension of coal mining will be essential if the several industries concerned are to be assured of adequate supplies of fuel for their development. Considering all these factors, it might be concluded that on implementation of the first five years stage of the development plan, the demand for mining machinery required for replacements, improvements etc., will be on the average, 75% more than the pre-war average demand. This demand does not include the machinery that will be required within the next five years for opening of new mines or for replacements overdue consequent upon the short supply during the six years of war. The introduction of coal washing and similar modern developments must also be taken into account in considering this matter.

This estimate worked out on the basis of production schedules is in close agreement with the figure arrived at in an independent way through the projection of the trend curve.

	1935-36 Index	1944-45 Index
	Rs. lakhs.	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	40	...
Anticipated value of annual demand for replacements and improvements etc., on implementation of the first five years stage of the development plan	...	127

(b) *Pulp & Paper Mills Machinery.*

This industry, except for one or two mills, is comparatively recent in its development. There is a large and growing demand for paper and paper boards and with all the requisite raw materials for pulp and paper manufacture available in abundant quantities in India, that demand could easily be met through the expansion of the industry.

The value of the pre-war average annual demand of pulp and paper mill machinery, required mostly for replacements and improvements is Rs. 20 lakhs on the basis of 1935-36 cost prices. The Paper Industry Panel visualises the expansion of the industry so as to produce in the year 1950-51, some 265,000 tons of paper and

paper board against the present capacity of 130,000 tons per year. This is more than a 100% increase in productive capacity. The demand in the year 1950-51 for pulp and paper mill machinery, for replacement and renovation only, can be estimated on this basis at 100% over the pre-war average demand, i.e., at an average value of Rs. 40 lakhs. This figure, however, does not include either the cost of plant that will be required during the next five years for installation of new units of manufacture, or the plant, equipment and machinery required for replacements which is overdue because of the short supply during the six years of the war.

The value arrived at in an independent way through the projection of the trend curve is Rs. 45 lakhs.

Since there is no appreciable difference between these estimates, the value of the demand on implementation of the first five years stage of the development plan is taken as Rs. 45 lakhs.

	1935-36 Index	1944-45 Index
	Rs. lakhs.	Rs. lakhs
Average annual value of pre-war demand for replacements and improvements etc.	20	...
Anticipated value of annual demand for replacements and improvements etc., on implementation of the first five years stage of the development plan.	45	82

(c) *Sugar Mills Machinery.*

This industry is well established in India. The trend curve for mill plant and machinery of this industry indicates that it has practically reached its average level of demand. The sugar Panel has, however, envisaged a 50% increase in demand within the next five years. The present annual production of sugar is 1.1 million tons and the annual production at the end of the next five years period is estimated at 1.6 million tons.

The pre-war average annual demand for plant and machinery required for replacement and improvement etc., comes to Rs. 60 lakhs on the 1935-36 cost basis. With the increase in production of 50%, envisaged by the year 1950-51, the demand for plant replacements and renovation may be estimated as Rs. 90 lakhs. From the trend curve, this demand has been worked out in an independent way at a value of Rs. 75 lakhs; the higher values of these values is taken here to indicate the demand on implementation of the first five years stage of the development plan.

	1935-36 Index	1944-45 Index
	Rs. lakhs.	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	60	...
Anticipated value of annual demand for replacements and improvements etc., on implementation of the first five years stage of the development plan	90	164

(d) *Leather Tanning and Curing Machinery.*

This industry has not been mechanised to any great extent. As the standard of living and the scale of wages improve, this industry will require more and more machinery. There will be a growing demand for high quality leather which will necessitate the use of more machinery than at present. The Leather Industries Panel has envisaged the expansion of the leather industry by 25% in the next five years.

The average annual value of the normal demand for plant, equipment and machinery required for replacements and improvements etc., during the pre-war years comes to Rs. 1.5 lakhs on the 1935-36 cost basis. At the rate of expansion envisaged by the Leather Industries Panel, the value of this demand in the year 1950-51 should be Rs. 2 lakhs. On the other hand, a study of the trend curve drawn and projected indicates that this demand in that year might be about Rs. 3 lakhs. In all probability, there will be some shortage of labour at the present low rate of wages and as the labour position becomes more acute, greater mechanisation of this industry should take place. The higher value at Rs. 3 lakhs is, therefore, taken to be the more probable demand value for this plant equipment on implementation of the first five years stage of the development plan.

	1935-36 Index Rs. lakhs.	1944-45 Index Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	1.5	...
Anticipated value of annual demand for replacements and improvements etc., on implementation of the first five years stage of the development plan	3.0	5.5

(e) *Boot and Shoe Manufacturing Machinery.*

The manufacture of boots and shoes at present is being done largely by manual labour. Only lately, has machinery been introduced in this industry and even so, the industry is not so fully mechanised as in foreign countries. With the rising standard of living, boot and shoe manufacture is likely to be more fully mechanised. Although the Leather Industries Panel anticipated a 25% rise in production in the next five years, the possibility of greater mechanisation of the industry in the next few-years may require a far greater percentage of manufacturing machinery. The pre-war average annual demand for this machinery for replacements and improvements is valued at Rs. 4 lakhs. It is more probable that the demand for this machinery on implementation of the first five years plan will be about 50% (and not 25%) over the pre-war demand. The anticipated demand on implementation of the first five years stage of the development plan for boot and shoe making machinery and required for replacements and improvements etc., is thus placed at Rs. 6 lakhs at the 1935-36 cost basis.

	1935-36 Index	1944-45 Index
	Rs. lakhs.	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	4	...
Anticipated value of annual demand for replacements and improvements etc., on implementation of the first five years stage of the development plan	6	11

(f) *Rice and Flour Mills Machinery.*

The rice and flour milling industry is well established in India and from the trend curve it seems that no large rise in demand for machinery for this industry is normally anticipated. No appreciable rise in demand can therefore be envisaged during the first five years stage of the development plan.

	1935-36 Index	1944-45 Index
	Rs. lakhs.	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	7	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan	7	12

(g) *Oil Crushing and Refining Machinery.*

Extraction of oil from oil seeds is essential for the manufacture of soaps, oil paints, varnishes and vegetable fats now in great demand in India.

The pre-war average annual demand for this machinery, required mostly for replacements and improvements etc., comes to Rs. 25 lakhs. The Oil and Soaps Panel has anticipated an increase of 25% in the production of such oils by the year 1950-51, and taking a proportionate rise in demand for machinery, the demand in the year 1950-51 may be placed at Rs. 31 lakhs. The comparative value arrived at in an independent way through the use of trend curves is Rs. 35 lakhs. The difference being slight, the higher estimate of Rs. 35 lakhs is taken to represent the demand on implementation of the first five years stage of the development plan.

	1935-36 Index	1944-45 Index
	Rs. lakhs.	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	25	...
Anticipated value of annual demand for replacements and improvements etc., on implementation of the first five years stage of the development plan	35	64

(h) *Saw Mill and Wood Working Machinery.*

The greater part of the wood working industry is not mechanised. As the standard of living rises, there will be an increasing demand for this type of machinery. The machinery requirements of this industry are so varied that it is not possible to arrive at the demand at the end of the first five years stage of the development plan in the same way as for other industries. A study of the trend curve indicates a 100% rise over the pre-war demand during the first five years of the development plan.

	1935-36 Index	1944-45 Index
	Rs. lakhs.	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	5	...
Anticipated value of annual demand for replacements and improvements etc., on implementation of the first five years stage of the development plan	...	10
		18

(i) *Tea Processing Machinery:*

Tea is in great demand throughout the world and India is well placed in regard to production of this commodity. The domestic demand for tea in India is expected to increase slowly along with the general improvement in the standard of living of the people. It may not, however, lead to more than a moderate rise in the demand for machinery for this industry.

The figures of production of tea anticipated during the next five years are not available. The machinery demand on implementation of the first five years stage of the development plan is placed provisionally at 50% over the pre-war average demand.

	1935-36 Index	1944-45 Index
	Rs. lakhs.	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	14	
Anticipated value of annual demand for replacements and improvements etc., on implementation of the first five years stage of the development plan.	...	21
		38

(j) *Metals Working Machinery (Excluding Machine Tools).*

This classification includes miscellaneous metal working machinery and does not include machinery which is used in the metallurgical industries. This machinery is in common demand for production of light engineering equipment. The development of this industry in India is so far uncertain and it is not possible to obtain any factual data regarding its production. A study of the trend curve, however, indicates a 100% rise in demand during the first five years stage of the development plan.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	5	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	10	18

(k) *Printing & Lithographic Pressing Machinery.*

The demand for this kind of machinery will expand with the spread of literacy in India. The nature and pace of industrial and commercial development of the country will also determine the increase in the demand of such plant and machinery. The development of the industry is to some extent related to the demand for paper. The paper panel has anticipated a 100% rise in demand during the next five years. Assuming that a good part of that paper is for printing, 50% rise in demand for this machinery can be anticipated at the end of the first five year stage of development plan.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	16	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	24	44

(1) *Unclassified Mill Work.*

The value of the pre-war annual demand for plant and machinery under the above classification comes to about Rs. 3 crores. It is unfortunate, however, that this large amount is shown under an unclassified category. The following industries among others are understood to have been included in this category :—

- (a) Metallurgical Industries Plant and Machinery.
- (b) Chemical Plant Equipment and Machinery.
- (c) Cement Mill Plant and Machinery.
- (d) Glass Works Plant and Machinery ; and
- (f) Refractory Works Plant and Machinery.

Reference has already been made to the development programme visualised by the Iron and Steel (Major) Panel and the Non-Ferrous Metal Industries Panel. The Chemical Industries Panel has anticipated a 100% increase in the production of sulphuric acid more than 300% in the production of soda ash, and considerable expansion in the production of other chemicals like caustic soda, calcium carbide and super phosphates. Some of

these industries have also been the subject of investigation by the Tariff Board. The expansion anticipated of the soap industry and the paints and varnish industry in the next five years is 100% and of the glass industry 25% over the present volume of production. The potential capacity of the existing cement mills is about 3 million tons per annum and it was considered reasonable to anticipate an increase in the production of cement by 3 million tons per annum by the year 1952. Of these industries, the most important are the metallurgical and chemical industries. A general increase of 125% over the prewar demands for machinery for these industries may, therefore reasonably be anticipated.

	1935-36 index	1944-45 index
Average annual value of pre-war demand for replacements and improvements etc.	Rs. lakhs. 260	Rs. lakhs. ...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	585	1065

(m) and (n) *Agricultural Machinery*:—

(Tractor-drawn ploughs etc. and spare parts for same).

Agriculture in India is not mechanised to any great extent. The development of industries envisaged by the several Industrial Panels demands a corresponding and parallel development of agriculture. The demand for agricultural machinery depends on the programme of mechanisation of agriculture regarding which no definite information is so far available. A 200% rise in demand however is visualised.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs
Average annual value of pre-war demand for replacements and renewals etc.	11	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	33	60

(o) *Jute Textile Machinery*.

The jute textile industry is well established in India. Broadly speaking, the productive capacity of this industry may be taken to have reached the economic maximum under present circumstances. However, it is possible to make new and special types of jute products and also maintain the foreign demand developed during the war period.

Moreover, an increasing quantity of jute can be processed in the country and the products exported instead of the raw material or the semi-finished commodity being exported as at present. There would also be certain improvements to, as well as replacement of obsolete plant and machinery. It may therefore be assumed that there would be some small rise in demand for this type of plant and machinery on implementation of the first five years stage of the development plan.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs.
Average annual value of pre-war demand for replacements and improvements etc.	70	...
Value of anticipated annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	80	146
<i>(p) Cotton Textile Machinery (Spinning).</i>		

This is the oldest and one of the most well established industries in the country and yet it is regrettable that India does not possess any cotton textile machinery manufacturing industry worth the name. It would be expected that a country operating nearly 2,002,000 looms and 10,300,000 spindles would have certain manufacturing units for the production of at least the simple types of textile machinery. Before the war, 99% of India's requirements of cotton textile machinery were obtained from abroad. In 1938-39, the value of imports amounted to Rs. 2.67 crores of which the U. K. supplied to the value of nearly Rs. 1.96 crores. Out of this, imports of spinning machinery came to half the total. Cloth is a prime necessity next to food, but while the desirability of increasing the manufacture of cloth is recognised, it is well known that one of the principal reasons impeding the expansion of manufacturing capacity of the Indian cotton textile industry is the difficulty of procuring textile machinery from abroad. India's inability to obtain textile manufacturing machinery from overseas has been due partly to the programme of industrial reconversion in the U. K. and the U.S.A. partly the low priority given by these countries to Indian orders for capital plant and partly to exchange and shipping difficulties. Even apart from expansion, the bulk of textile machinery in use in India is about 40 years old and replacement is overdue. The post-war Planning Committee of the Textile Control Board has estimated that some 10 million spindles would be required to carry out a thorough renovation programme. Besides, 2.75 million spindles would be required to enhance the textile output to 7,200 million yards per annum, the target set for the industry to be reached in 1950-51. Of these, 3.3 million spindles will be required within five years to maintain the present annual per capita consumption of cloth of only 12 yards. These figures clearly bring out the magnitude of the demand and the vast scope for a well organised textile machinery industry. Textile Panel recommended (i) import of productive machinery. (ii) installation of balancing machinery; (iii) replacement of old machinery by new machinery and (iv) installation of new mills to the extent of 2.75 million spindles. The existing capacity is placed at 10.29 million spindles. This would mean that much additional and newer types of machinery would be required for replacement in the older mills,

The demand for machinery for replacement and renovation, on implementation of the first five years stage of the development plan, can therefore be taken at the 50% more than in the pre-war period. The projection of the trend curve indicates the demand in the

years 1950-51 at a value of Rs. 140 lakhs. This is rather on the low side and the higher figure of Rs. 150 lakhs is taken to represent the demand on implementation of the first five years stage of the development plan.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs.
Average value of pre-war annual demand required for replacements and improvements etc.	100	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	150	273

(g) *Cotton Textile Machinery (Weaving).*

There is some manufacture of handlooms in India which are made over to the handloom weaving industry. This however, represents only a fractional portion of the country's demand for weaving machinery. The Planning Committee of the Textile Control Board has estimated that 200,000 looms will be required to carry out a thorough renovation programme while some 40,000 looms will be required to enhance the textile output to the target figure of 7,200 million yards per year to be reached in 1950-51. Of these, 50,000 looms will be required within five years maintain the present annual per capita consumption of cloth of only 12 yards. If the consumption is to be raised even by 50% per head, it will be appreciated that more looms as well as spindles will be required. As in the case of spinning machinery, a 50% rise in demand for this type of machinery can be anticipated in the next five years. The projection of the trend curve indicates the demand in the year 1950-51 at a value of Rs. 70 lakhs. This is rather on the low side and the higher figure of Rs. 80 lakhs is taken to represent the anticipated annual demand on implementation of the first five years stage of the development plan.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs
Average value of pre-war annual demand required for replacements and improvements etc.	55	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	82	149

(r) *Cotton Textile Machinery (Other Kinds).*

This category of plant covers the machinery usually required in the preparatory stages of cotton textile goods manufacture. It includes gins, bale presses, bale breakers, hopper feeders, scutcher and lap machines, carders and combers etc. The Cotton Textile Industry Panel has envisaged an expansion of 50% over the present productive capacity. At 50% rise, the value of the demand in the year 1950-51 for this plant and machinery should be Rs. 45 lakhs. The value arrived at in an independent way through the projection of the trend curves is also Rs. 45 lakhs per annum.

	1935-36 index Rs. lakhs	1944-45 index Rs. lakhs
Average value of pre-war annual demand required for replacements and improvements etc.	30	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	45	82

(s) *Cotton Textile Machinery (Printing).*

In spite of the cotton textile industry being a well established Textile industry, the printing side of the industry has not been adequately developed. The use of printed fabrics is however increasing in favour and the demand will continue to expand as the standard of living rises. The same rate of expansion, i.e., at 50% as envisaged for the cotton textile industry cannot therefore be expected to be sufficient in this case. Therefore a 75% rise over the pre-war demand has been anticipated, on implementation of the first five years stage of the development plan.

	1935-36 index Rs. lakhs	1944-45 index Rs. lakhs
Average value of pre-war annual demand required for replacements and improvements etc.	4	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	7	13

(t) *Cotton Textile Machinery (Bleaching & Dyeing).*

The bleaching and dyeing side of the cloth textile industry is not yet sufficiently developed. As in the case of printing machinery, therefore, a 75% rise in this demand can reasonably be anticipated

on implementation of the first five years stage of the development plan.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs
Average value of pre-war annual demand required for replacements and improvements etc.	4	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	7	13

(u) *Wool Textile Machinery.*

This industry can be considered to be still in an early stage of development, in spite of the great demand in India for woollen and worsted fabrics. It is understood that a 60% rise in production is envisaged for it by the Panel concerned. With the average value of pre-war annual demand for the plant and machinery at Rs. 2.5 lakhs, the value of the demand on implementation of the first five years stage of the development plan works out to Rs. 4 lakhs per annum on the basis of this estimate.

On an independent study and projection of the trend curve, this demand is estimated at a value of Rs. 5.0 lakhs per annum.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs
Average value of pre-war annual demand required for replacements and improvements etc.	2.5	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan,	5.0	9

(v) *Textile Plant and Machinery (Other Kinds).*

The plant and machinery required in the following textile industries is included in this category :—

- (a) Silk Textile Industry ;
- (b) Rayon & Artificial Silk Industry ;
- (c) Ready-made Clothing & Hosiery Industry.

There is already a large demand for these products and with a rise in the standard of living in India, an increase in demand, especially for silk and artificial silk products, can be expected.

The Silk Industry Panel has not suggested any increase in production during the five years stage of the development plan. The Rayon & Artificial Silk Panel has, however, envisaged the establishment of seven manufacturing unit requiring capital goods of the value of Rs. 10 crores on the basis of the present-day prices. The Ready-made Clothing and Hosiery Panel has estimated the demand for capital goods for the next five years at Rs. 10 crores on the basis of the present-day prices. At the pre-war rates, the combined cost for capital machinery works out at about Rs. 10 crores. Even assuming a 15-year life * for this machinery, the value of plant and machinery that would be required for replacements etc. would be Rs. 67 lakhs a year. The annual demand after the next five years for replacement on account of these new plants is provisionally estimated at a third of what would otherwise be required, i.e., at a figure of Rs. 22 lakhs.

The value of plant and machinery required for replacements and improvements for the existing industries is estimated from the projection of the trend curve at Rs. 27 lakhs per annum.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs
Average value of pre-war annual demand required for replacements and improvements etc.	20	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	50	91

(w) *Textile Shuttles.*

These machine parts are in great demand in the weaving industry and production should develop with the expansion of the industry. The handloom industry also requires these products in large quantities. The various Textile Panels have envisaged an expansion of the industry by about 50% for cotton textiles, 60% for wool textiles. No definite targets are so far suggested for the development of the silk industries. The present demand for textile shuttles based on the import values for the year 1943-44 and 1944-45, is valued at Rs. 17 lakhs. The trend curve, on the other hand, indicates a steep rise in demand over the pre-war period and it is therefore anticipated that the demand during the next five years would be still higher. A 200% rise in demand over the pre-war average demand is, therefore, visualised.

* For the Rayon Industry, the Panel has proposed a 10-year life for machinery.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs
Average value of pre-war annual demand required for replacements and improvements etc.	7	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan ...	21	38

(x) *Textile Bobbins;*

Bobbins are in great demand for spinning and weaving. The Cotton Textile Panel has envisaged an expansion of the cotton textile industry by 50%, but this does not include the handloom industry, the jute textile industry and the silk industry. The trend curve indicates a continuous rise in demand during the past 10 years. Assuming this trend to continue up to the year 1950-51, the probable annual demand at the end of the next five years works out to a value of Rs. 55 lakhs. This is a 77% rise over the pre-war average demand.

	1935-36 index	1944-45 index
	Rs. lakhs	Rs. lakhs
Average value of pre-war annual demand required for replacements and improvements etc.	31	...
Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan ...	55	100

SUMMARY.

15. Pre-war Average Demand and Anticipated Demand for Industrial Plant & Machinery (Heavy) on Implementation of the First Five Years Stage of the Development Plan.

Plant, Equipment and Machinery.	Average annual value of prewar demand for replacements and improvements, etc. Rs. lakhs.	Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan. Rs. lakhs.		
	Expressed in terms of 1935-1936 index.	Expressed in terms of 1935-1936 index.	Expressed in terms of 1944-45 index.	
(a) Mining Machinery ...	40	70	127	
(b) Pulp and Paper Mills Machinery ...	20	45	82	
(c) Sugar Mills Machinery...	60	90	164	
(d) Leather Tanning and Curing Machinery ...	2	3	6	
(e) Boot and Shoe Manufacturing Machinery ...	4	6	11	
(f) Rice and Flour Mills Machinery ...	7	7	13	
(g) Oil Crushing and Refining Machinery ...	25	35	64	
(h) Saw Mills and wood working Machinery ...	5	10	18	
(i) Tea Processing Machinery	14	21	38	
(j) Metals Working Machinery	5	10	18	
(k) Printing and Lithographic Presses	16	24	44	
(l) Unclassified Mills Work	260	585	1065	
(m) and (n) Agricultural Machinery: (Tractor-drawn ploughs and parts etc.)	11	33	60	
Total for Non Textiles.	469	939	1709	

Plant, Equipment and Machinery.	Average annual value of prewar demand for replacements and improvements etc.	Anticipated value of annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.		
	Rs. lakhs.	Rs. lakhs.		
	Expressed in terms of 1935-1936 index.	Expressed in terms of 1935-36 index.	Expressed in terms of 1944-45 index.	
(o) Jute Textile Machinery...	70	80	146	
(p) Cotton Textile Machinery (Spinning.) ...	100	150	273	
(q) Cotton Textile Machinery (Weaving.) ...	55	82	149	
(r) Cotton Textile Machinery (Other Types.) ...	30	45	82	
(s) Cotton Textile Machinery (Printing.) ...	4	7	13	
(t) Cotton Textile Machinery (Bleaching and Dying.) ...	4	7	13	
(u) Wool Textile Machinery ...	3	5	9	
(v) Textile Plant and Machinery (Other Kinds.) ...	20	50	91	
(w) Textile Shuttles. ...	7	20	38	
(x) Textile Bobbins ...	31	55	100	
Total for Textiles.	324	501	914	
Grand Totals.	793 say (8 crores)	1440 say (14 crores)	2623 say (26 crores)	

16. Demand and supply during war period :

Due to the abnormal conditions created by the war, only part of the normal demand for replacements and improvements could be met during the last six years. This pent-up demand is very high and it is reasonable to assume that it will be satisfied within the next five years. Even though this demand is strictly speaking, outside the

sphere of postwar planning, it is taken into account in this Report so as to estimate more accurately the extent of plant and machinery that will have to be imported during the next five years.

Pent up demand of war period.	1935-36	1944-45
	index	index
	Rs. lakhs	Rs. lakhs
(a) Mining Machinery	125	228
(b) Pulp and Paper Mills Machinery	45	82
(c) Sugar Mills Machinery	220	400
(d) Leather Tanning and Curing Machinery	6	11
(e) Boot and Shoe Manufacturing Machinery	18	33
(f) Rice and Flour Mills Machinery	28	51
(g) Oil Crushing and Refining Machinery...	115	209
(h) Saw Mills and Wood Working Machinery	Nil	Nil
(i) Tea Processing Machinery... ..	10	18
(j) Metals Working Machinery	8	15
(k) Printing and Lithographic Presses	55	100
(l) Unclassified Mill Work	560	1019
(m) and (n) Agricultural Machinery (Tractor drawn ploughs and parts etc.)	20	36
(o) Jute Textile Machinery	250	455
(p) Cotton Textile Machinery (Spinning)	200	364
(q) Cotton Textile Machinery (weaving)	110	200
(r) Cotton Textile Machinery (Other Types)	90	164
(s) Cotton Textile Machinery (Printing)	20	36
(t) Cotton Textile Machinery (Bleaching and dying)	20	36
(u) Wool Textile Machinery	5	9
(v) Textile Plant and Machinery (Other Kinds)	55	100
(w) Textile shuttles	Nil	Nil
(x) Textile Bobbins	Nil	Nil
Total.	1960 say	3536 say
	(20 crores)	(36 crores)

17. Estimated total requirements for new projects in the first five years.*

The various Industrial Panels have proposed definite targets of development and expansion for the several industries concerned during the next five years. In most cases, they have estimated the requirements for capital goods, i.e., plant, equipment and

* See para 13.

machinery needed for the installation of new or additional units of manufacture. These estimates are indicated below.

Mining Machinery	...	...	3 crores. @
Pulp and Paper Mills, Machinery	...	...	10 "
Sugar Mills Machinery	...	...	10 "
Power Alcohol Plant	...	...	2 "
Leather Goods Machinery	...	...	3 "
Oil Crushing and Refining, paints and varnishes and soaps manufacturing machinery.	...	...	3 "
Metals Working Machinery	...	...	3 "
Iron and Steel Works Machinery	...	...	25 "
Non-ferrous Works Machinery	...	...	2 "
Refractories and Cement Mills Machinery	...	...	7 "
Heavy Chemicals Works Machinery	...	...	11 "
Rayon or Artificial Silks Mills	...	...	10 "
Ready-made Clothing and Hosiery	...	...	10 "
Cotton Textile Mills Machinery	...	...	32 "
Woollen Textile Mills Machinery	...	...	33 "
Artificial Fertiliser Plant and Machinery	...	...	10 "

(This list is not necessarily complete)

Until organised and large scale manufacture of Industrial Plant and Machinery is undertaken, a large part of these requirements will have to be imported. There is no reason, however, why steps should not be taken from now on, and definite schemes formulated and implemented, for building up manufacture of plants and machinery within the country, along with the growth of other basic and secondary industries. Indian industries have suffered owing to lack of machinery both during World War II and since the termination of hostilities and this experience should carry conviction of the vital need of establishing a comprehensive machinery manufacturing industry within the country.



@ The values given here are, as stated by the several Panels, on the basis of immediate post-war costs.

CHAPTER III

**PRESENT POSITION REGARDING FACILITIES FOR
MANUFACTURE OF INDUSTRIAL PLANT AND
MACHINERY IN INDIA.**

Note:—In this chapter the Panel examines the facilities existing in India for the manufacture of Industrial Plant and Machinery (Heavy).

18. General:

Although a heavy engineering industry had been in existence for nearly a hundred years, no substantial progress had been made in the direction of manufacture of heavy machinery of different types used by the various industries in the country. The engineering concerns, the most important of which are under British Control* were initially concerned mainly with structural and repair work for railway and ship. Of late years, their sphere of operations had developed in other and important directions like the manufacture of railway wagons, bridges, tanks, cranes, etc., mostly involving structural work. Such manufacture had been dependent mainly on the demands from Government and other quasi-public bodies like Port Trusts, Municipalities, etc. More recently and particularly since the war, several more engineering firms have come into being. Appendix III hereto is a list of some of the firms which are interested, in some form or other in the manufacture of industrial plant and machinery. The list is by no means exhaustive and only mentions the more important firms.

The manufacture of such types of industrial plant and machinery as machine tools, prime-movers and certain kinds of electrical machinery etc. is being expanded in the country. But these categories of products do not come within the scope of this Panel and are, therefore, not dealt with in this Report.

The Textile Machinery Corporation Ltd. set up at Belguria (Bengal) and Gwalior, to manufacture frames in the former place and looms at the latter, is the only concern of its kind so far established in India for the manufacture of one particular type of industrial plant and machinery. Certain other concerns also manufacture looms along with other products; one such firm, Copper Engineering Ltd., Satara commenced the manufacture of textile looms in 1930, but their capacity for this work is somewhat restricted for want of facilities. There are other concerns which manufacture handlooms for the cottage industry.

Certain parts of machinery for sugar mills such as cane crushers and transmission gearing, are being manufactured in the country, but mainly as job work and not in an organised manner. Substantial portions of the machinery of cement mills as well as certain

*E.g. Braithwaite & Co., Britannia Engineering Co., Burn & Co., Jessop & Co. and Richardson & Cruddas & Co.

other simple types of equipment such as screens, filter rames, kettles tanks, etc., are also being made in India. Similarly, certain sizes of weighing scales, asphalt and concrete mixers, oil expellers, and a few types of hydraulic presses are being manufactured. But in all such manufacture the parts which involve precision work and a complex technique of construction are almost invariably imported. Strictly speaking these units cannot be considered as producers of complete units of heavy industrial, plant and machinery. Appendix IV hereto shows, under broad groups, the plant and machinery required by certain major industries, with details of various types of machines falling within these groups. Since but few of the items shown are as yet wholly produced in India, this list serves to show the leeway which must be made good before India can be regarded as self supporting in the supply of the plant and machinery required by the several major industries mentioned.

19. Material and Ancillary products of Construction.

(a) General.

Without adequate supplies of essential materials it is, of course, not possible to establish the manufacture of plant and machinery but even in the present stage of development of the metallurgical industries in India, the greater part of the supplies needed can be produced. The iron and steel industry is the source from which a substantial portion of construction materials will come. There are three large iron and steel works in India and several re-rolling mills using scrap material. The total production of steel in India at present is some one and a quarter million tons a year. Pig iron can be had from these steel plants, while substantial quantities of scrap will also be available. The requirements of iron and steel for this industry will be considerable and the Panel desire to express their concern at the prevailing condition wherein the iron and steel industry is unable to meet even the present day demand. In order to ensure the necessary supplies for the manufacture of plant and machinery of the types visualised in this Report, it is absolutely essential that the programme for the expansion of the iron and steel industry should be implemented without delay. A given tonnage of industrial plant and machinery, generally speaking, requires a corresponding weight of iron and steel, including alloy steels plus about 15% wastage. Non-ferrous alloys will be required to the extent of 10% by weight of the finished product for the construction of special machine parts.

(b) Iron and Steel (Plain).

Most of the iron and steel required will be in the form of castings, forgings and structurals like plates, sheets, bars, flats, angles, etc. These materials, in the different shapes required, are now being rolled in large quantities in India. Practically the entire requirements can be met directly from the iron and steel works already established in India provided the programme of expansion is immediately and effectively implemented.

(c) Alloy Steels.

For highly stressed machine parts and where resistance to corrosion is particularly necessary, alloy steels will be required. Such alloy steels in limited quantities are also now being manufactured in India and further development is contemplated in regard to manufacture of different varieties of alloy steels. During the war, production of alloy and carbon tool steels rose fourfold to 12,000 tons per year. At the same time high speed tool steels, stainless steels, nickel and special manganese steels and nickel chrome molybdenum steels were produced, in many cases for the first time, to meet a good part the large demands of ordnance and war factories. The Tata Iron and Steel Co. Ltd., and the metals sections of the Ordnance Factories at Ischapur, Cawnpore and Muradnagar are well equipped for such manufacture and are in a better position to meet the requirements of the indigenous heavy machinery manufacturing industry. The alloying elements required for the manufacture of these alloy steels are mainly manganese, silicon, copper, nickel, cobalt, chromium, molybdenum, vanadium and tungsten. A good portion of these ferro alloys will have to be imported initially as they are not yet being manufactured in the country.

(d) Non-ferrous alloys.

Brass, bronze, aluminium alloys and white metals are the common non-ferrous alloys that will be required for this industry. They will be required mainly for tubes, bearings, fittings and instruments. In the chemical industries, where plain steels will not in all cases, be suitable, non-ferrous alloys will be necessary. The principle alloying elements required for the manufacture of these non-ferrous alloys are copper, zinc, tin, aluminium and antimony. The greater part of these metal are, at present, imported; but it is expected that, in course of time, a substantial part of India's demand for copper, aluminium and antimony would be met through development of metallurgical industries in the country. The major portion of the production of non-ferrous alloys in India is now restricted to a few concerns like the Indian Copper Corporation at Ghatsila, the Indian Aluminium Co. Ltd., and the Aluminium Corporation of India Ltd. The Ordnance Factories at Ambernath and Katni are well equipped for conversion of the non-ferrous alloys to sheet form and a wide variety of extruded sections.

(e) Iron Foundry.

The foundry industry is next in importance to the metal industries for machinery manufacture, since castings are used extensively in machinery manufacture. Although there are several iron foundries distributed throughout India, the majority being attached to engineering works already in existence, very few foundries can be said to be organised on modern lines, and capable of turning out the heavy and high quality castings required for the machinery

industry. Most of the foundries in India have rather small size cupolas; there is usually very much sand contamination and, except in a few foundries, there is no sand conditioning and control, nor does the importance of using good quality sands appear to be realised. There is also little metallurgical control. Except in rare cases, there is no mechanical equipment for the proper cleaning of the casting nor are there any annealing furnaces provided in the foundries to permit annealing of casting where such treatment is required. Further, the modern technique of metal pouring and control is not usually employed or even understood. While modern foundry practice may not have been found necessary for the types of castings in demand in the past, it will be essential for a well-developed machinery industry. It might be added that Indian manufacturers will have to realise the importance of good foundry practice and technique and of developing mechanised foundries, with a view to producing high quality castings on a competitive basis. In this connection it is of special importance that sources of supply of good quality foundry sands should be located, and that where necessary transport facilities, should be arranged. In some cases foundry sands will have to be transported from a considerable distance, if natural sands despoits are regarded as the only source of supply. To keep transport costs as low as possible manufacturers might consider preparation of synthetic moulding sands. This moulding sand can be made from washed silica with admixture of various types of clay bonds and may be found to be cheaper in the long run since it could be used continuously by replacement merely of the clay bond.

(f) *Steel foundry.*

Steel founding in India is, generally speaking, far below the requirements of the country, both as regards quantity and quality. The manufacture of steel castings is a highly technical progress which involves employment of special equipment and metallurgical control. Only a few steel foundries in India are making steel castings of good quality, the most important of these are, the Tata Iron and Steel Co. Ltd., the Steel Corporation of Bengal, the Mysore Iron and Steel Works, Bhadravati, the Kumardhubi Engineering Works, the Bharatia Electric Steel Co., Calcutta, and certain of the Ordnance Factories and Railway Workshops. In the Ordnance Factory at Muradnagar (U.P), high grade steel castings are made, but most of the castings produced are of small to medium size. Most steel foundries established in India require better technique in sand control and much remains to be done on the metallurgical side regarding control in melting and pouring, and the employment of mechanical sand conditioning equipment and up to date annealing furnaces. Considerable expansion in the production of steel castings of good quality is essential if Indian steel foundries are to meet the demand of the machinery manufacturers in the country.

(g) *Forging Industry:*

Where high stresses are involved in machinery parts, it is usual to employ rolled or forged steel parts. Therefore equal in importance

to the foundry industry, is the forging industry, which must cover the full range of requirements from heavy forgings such as large crank shafts, which may be produced singly, down to medium and small sized drop forgings which may be produced on a mass production basis. Apart from the Ordnance Factories and a few private firms like the Indian Standard Wagon Co., where forgings are made, mostly for use in these installations, there is no organised forging industry in the country. The number of highly stressed and complex parts required for the machinery industry is large and a properly developed forging industry is essential for the establishment and growth of the machinery industry.

(h) *Welding:*

This process has made great advance during recent years and has been adopted extensively in the western countries, for the fabrication of machinery parts, as a substitute for castings. Special technique is required to make welding really successful and competitive with other methods of fabrication. In order to develop this technique in India particular attention should be devoted to it in technical training centres.

(i) *Riveting:*

This practice is well developed in India as far as the employment of the method is concerned, and can be depended upon for the production of fabricated structures of all kinds, from lightly stressed parts to the highly stressed fabricated structures required in bridge construction and pressure vessels. The principle drawback in India to the use of this method is the lower output of riveters in India as compared to other countries. The peak demand for riveted work during the war also revealed a shortage in capacity for the manufacture of good quality rivets. This shortage may be expected to re-appear as general industrial development takes place. With the further development of the technique of welding, however, riveting will, to some extent, give way to welding.

(j) *Forming and deep-drawing:*

This is a very important ancillary industry, essential for the development of manufacture of industrial plant and machinery. Except in a few firms manufacturing fans and small motors, sanitary equipment, household utensils and similar goods where forming and punching equipment is used in a small way, there is very little of this type of work being done in the country. In certain workshops such as, for example that of Jessop and Co. and other wagon building concerns, there are some heavy forming and trimming presses. There is, however, practically no deep drawing and heavy pressing work being done except in the Ordnance Factories. Most of the work done by the Ordnance Factories is restricted to the manufacture of shells and cartridge cases.

(k) *Die Casting:*

Apart from the Ordnance Factories there is very little diecastings production capacity in India. The die casting industry is important to industrial expansion generally and should be developed.

(l) *Pipe and Tube Manufacture:*

There is no seamless tube manufacturing industry in India. Prior to the war a limited quantity of welded pipe was made, up to 2½ inches diameter from imported strip, but production ceased during the war owing to the difficulty in obtaining strip. It is understood that plans for the manufacture in India of steel strip have advanced sufficiently to enable the industry to be re-established in the near future, using indigenous material. To make India self-supporting in regard to requirements of high quality tubes and pipes the establishment of a seamless tube manufacturing industry is essential.

For non-ferrous alloy tube manufacture, the extrusion press and drawing equipment at the Ordnance Factory, Katni, is suitable, and considerable quantities of tubing of normal sizes and dimensions could be produced there.

(m) *Cold Drawn Bright Steel Bar:*

This material is in extensive demand in engineering industries. Unfortunately, it is not manufactured in India and at present, all engineering workshops except Ordnance Factories are obliged to utilise black steel bar, which has to be machined for nearly all purposes, unless of course, the workshops import bright bar. Bright bar is essential in the employment of modern mass production machine tools such as single and multi-spindle autos, since the chucking mechanism on these machines operates to such a close range that black bar cannot be fed into the machines. Non-availability of bright bar increased manufacturing costs considerably even on general purposes machines and it is necessary that special efforts should be made to establish an industry for producing bright bar of all sizes and sections required in the engineering industry.

(n) *Gears, and Gear Units:*

High quality heat treated gears, manufactured from special quality steels, are essential for the manufacture of industrial plant and machinery. Although Ordnance Factories and several engineering firms manufacture gears, there is not a single firm in the country specialising mainly in the manufacture of high quality gears and gear units. The establishment of an industry, specialising in the manufacture of these products and possessing all the latest types of machinery and heat treating plant for producing hardened and ground gears, etc., is of the utmost importance for the manufacture of industrial plant and machinery.

(o) *Other Ancillary Requirements:*

A list of some of the ancillary requirements for industrial plant and machinery manufacture, certain of which have already been mentioned in this report, will be found in Appendix V hereto. It is desirable that the manufacture of such products as are not already being made in India should be established as early as possible.

20. **Ordnance Factories:**

(i) Certain of the Ordnance Factories have excellent plant, equipment and facilities suitable for the manufacture of machinery or

or assisting private enterprise to this end. These factories were planned initially to manufacture war requirements. During the recent war, they were developed to a considerable extent with many additions and improvements. The Factories are well equipped with upto date machinery on an extensive scale and if their technique, equipment and skilled labour are availed of, they would be useful in the development of a heavy engineering industry at any rate in the initial stages. The possibility of utilising the resources of these factories for assisting private enterprise in the manufacture of industrial plant and machinery should be seriously investigated.

(ii) First grade plain and alloy steels are being manufactured and rolled or cast at the Ordnance Factories at Ischapur, Cawnpore and to a limited extent at Muradnagar. The furnaces at the Ordnance Factories at Ischapur and Cawnpore are 20-25 ton capacity, which is a useful size for manufacture of high grade alloy steels. The Ischapur factory has also an electric arc furnace. At Muradnagar there are high frequency electric furnaces of the most modern type for making high grade steels in small ingots and castings, also two open hearth furnaces of 5 ton capacity each, and an electric arc furnace.

(iii) For the production of non-ferrous metals, there are several batteries of fully equipped modern type melting furnaces, both high frequency and induction types, complete with rolling mills, at the Ordnance Factories at Ischapur, Ambernath and Katni. The mills are mainly for rolling of copper and brass sheets to a maximum of 28-inches width and any thickness down to 0.002". All these rolling mills are complete with annealing furnaces, pickling baths, slitters etc. Another important item of equipment available at the Ordnance Factory at Katni is the modern hydraulic extrusion press with its full complement of drawing and straightening presses, by means of which the manufacture of extruded copper, brass and aluminium sections of various sizes and shapes, including seamless non-ferrous tube up to 5" diameter and 21 feet lengths, could be undertaken. An extrusion press of an older type is installed at the Ordnance Factory, Ischapur.

(iv) A wide variety of wood working machinery for turning out all types of wood products is located at the Ordnance Factories at Jubbulpore and Khamriah, along with the necessary kilns and seasoning plant. All types of wood products like bobbins and wooden frames required for machinery manufacture can be made there, subject to the provision of the necessary balancing plant.

(v) Equipment in Ordnance Factories for making iron castings is available in limited capacity only and need not be described here.

(vi) Steel castings, in respect of which there is limited capacity in private industries, can be made at the Ischapur, Cawnpore and Muradnagar Ordnance Factories. At the Muradnagar Factory, sand cleaning and conditioning equipment of the latest type is installed. The size of casting produced at Muradnagar is generally limited to about 5 tons. This capacity would meet part of India's immedi-

ate requirement for manufacture of industrial plant and machinery. Castings of a larger size can be made at either Ischapur or Cawnpore.

(vii) Practically the whole of the forgings required for the industry, from the smallest forged components to the heaviest sizes like large sized crank shafts, can be made at several of the Ordnance Factories. The Ordnance Factories at Ischapur, Cawnpore and Jubbulpore are provided with heavy quick acting steam hydraulic forging presses of the most modern types. There are two 1500 ton presses at Cawnpore, one 2000 ton press at Ischapur and three 1000 to 1500 ton presses at Jubbulpore. Besides, there are several forging presses and power hammers of medium size at these factories, together with the necessary heat treatment equipment and metallurgical control for producing forgings of the highest quality. Generally speaking, the capacity available should be sufficient for India's requirements for some time to come.

(viii) For deep drawing, forming, punching and trimming, presses are available in several of the Ordnance Factories and size of work covered being of small to medium type, mostly restricted to the manufacture of shells, cartridge cases etc. The Ordnance Factories at Khamariah (Jubbulpore), Cawnpore, Cossipore and Ambernath, are extensively equipped for light press work.

(ix) For machining operations, the equipment provided in the Ordnance Factories is extensive and of first class types. There are innumerable varieties of single purpose and special machines of the latest foreign designs. The machine shops of the Ordnance Factories at Cossipore, Ischapur, Cawnpore, Amritsar, Jubbulpore and the Bren Gun Factory at Hyderabad are especially well equipped.

There is also a large number of milling machines, turret lathes, surface grinders, cylindrical grinders etc., in Ordnance Factories and many special machines such as internal and external grinders, thread grinders, jig borers, horizontal and vertical boring machines, and automatic die sinkers. The tool rooms of certain Ordnance Factories are also fully equipped with the latest types of machine tools and highly skilled labour, together with the necessary high precision measuring and testing equipment for holding work to close tolerances.

For heavy machinery manufacture, large size machine tools are provided at Amritsar and Cawnpore. There is a variety of other machinery equipment of miscellaneous types in the Ordnance Factories such as drawing and straightening machinery, equipment for the manufacture of bullet cores etc. There are also electric plating installations to make the factories self-contained in this class of work.

21. Air-craft Factories.

The recent war had been responsible for the establishment in India, of factories for assembly and repairs of aircraft. Although the first aircraft factory that was established at Bangalore was originally designed and meant for manufacture of gliders, it gradually became

a unit for the assembly and repair of aircraft. Gradually, similar factories for repairs to aircraft were also established at Poona, Bangalore, Calcutta and Cawnpore. Some good machine tool equipment is available in the aircraft factories at Poona, Bangalore and Dum Dum (Calcutta) which might be of use in the development of heavy machinery manufacture.

22. Railway Workshops,

These are some of the oldest workshops in existence in India. Although there is a large number of machine tools in the Railway Workshops, many of the machines are obsolete. These workshops are mainly concerned with maintaining the rolling stock of the railways, each particular railway having its own workshops. Workshops at Hyderabad (Deccan) and the N.W.R. workshop at Lahore are some of the better equipped of these plants. The tool room at the N.W.R. Workshop at Lahore has also a few modern machines tools such as thread grinders, jig borers, together with the necessary control equipment. The work done in some of the better types of workshops is of high enough quality for the manufacture of heavy machinery, but it is doubtful whether any spare capacity would be available, since these workshops will be fully occupied with the maintenance of the railways themselves which will have to keep in step with general industrial development.

23. Raw Materials.

We have already dealt with this subject in some detail in the previous paras.

24. Power and fuel.

The demand for power for this industry will not be high but such power as is required should be made available at cheap rates. Cheap power can be made available only through the development of hydro-electric power projects or high capacity modern thermal power stations distributing through grid systems. In expanding power resources by the construction of additional thermal power stations, however, due regard must be paid to the need for conserving resources of metallurgical coals, by designing new stations for operation on low grade coals. Apart from the fuel required for the generation of power, coal in large quantities would not be required by this industry. Available fuel supplies, even at the present stage of development of coal mining in the country, do not appear to be sufficient for the purposes of this industry, and attention is invited to the following extract from the report of the Indian Coal Fields Committee. "The present gap between supply and requirements is estimated at about 4 million tons per annum. In order to balance supply and demand, the Committee suggest that production and transport capacity should be stepped up at the rate of one and a half million tons per annum".

25. Transportation.

The transportation problem is an important factor in the development of this as of other industries. Distances in India between the sources of supply of raw materials, centres of production and the

markets are great, and railway freight charges are high, which go to increase the cost of both production and distribution. In this connection India suffers particularly through lack of navigable inland waterways, which in other countries are used extensively as an economical means of carrying raw materials to factories and finished goods to consuming centres. In the U.S.A., for example, the steel industry is located in an area where its principal raw materials have to be brought from a distance of 1,000 miles away. This has been rendered economically possible by an excellent waterways system, which reduces the cost of transport to the minimum. The development of efficient and economic modes of transport in India, covering rail and road and where possible water, is a pre-requisite of industrialisation and indispensable for a balanced location of industrial units. In certain cases, it may be necessary to adjust transportation rates so as to mitigate geographical disadvantages and assist regional development of the industry.

26. Technicians and skilled labour.

It is hardly necessary to emphasise that many categories of high class technicians, engineers, skilled and semi-skilled men would be required for this industry. That there is a serious lack of qualified and experienced technicians, skilled engineers as well as different kinds of skilled labour in India is generally recognised. This deficiency was, to some extent, made up during the war when Indian technicians and skilled labour gave a very good account of themselves in war industries, including Ordnance Factories, and came up to the standards of many western countries, without possessing equally long experience or literary qualifications. Missions from other countries as well as industrialists and experts from abroad and authorities in this country have paid tribute to the competence and skill of Indian workers. It was found that educated men not accustomed to manual labour were also ready to take to it and showed good skill. It is necessary, therefore, to mobilise such skill and knowledge as is latent in the country for industrial purposes. It is true that Indian workmen are still not fully acquainted with the complexities of machine making. But given adequate opportunity, training and economic incentive, there should be little difficulty in obtaining the necessary skilled labour. Undoubtedly, there are handicaps such as illiteracy and social customs, as well as a certain amount of reluctance on the part of educated men to undertake manual or bench work, which can all be removed by planning and organised efforts, in which industrialisation itself will be of help.

In regard to the training of technicians and engineers, India suffers from a dearth of suitable technical institutions and even those which exist suffer through lack of equipment and staff, mainly owing to financial reasons. We have already dealt with this question in Chapter I but we again stress here the importance of technical institutions having qualified engineers for giving instruction, both technical and practical. The instructional staff of such institutions should

include specialists in the practical side of such subjects as foundry practice, metallurgy and machining, whose services might be made available to industrialists when required.

27. Capital goods and Machine tools.

The production and maintenance of high quality standards of machinery will depend primarily upon the employment of good and suitable capital goods, including machine tools, for manufacture of heavy machinery. The machine tool industry in India has developed considerably during the war period, but the manufacture of machine tools is still restricted to simpler types, such as small medium-sized lathes, drilling machines, shapers, a few milling machines and capstan lathes which are normally in demand for jobbing workshops. The machine tool industry will have to be developed much further for the purpose of supplying the machines necessary for heavy engineering industry.

28. Procurement of designs and Production technique in the Initial Stages of the Industry.

Apart from the production technique involved, the manufacture of plant and machinery requires, above all, proper designing facilities, particularly in the case of specialised plant. At the present stage of industrial development in India, the art of design has not reached the same level as production. The development of proper designs is a long process and involves a high degree of technical ability and extensive experience as well as necessary equipment, organisation and financial resources. The first class designs developed in countries like the U.S.A., the U.K., and on the Continent of Europe are the outcome of nearly a century of intensive technological research and progress. Most of such valuable designs are covered by patents. In India, where design technique is hardly developed, there has been a tendency to copy foreign designs and that too, not always in a satisfactory manner. For the present, however, until original designing is developed in the country, it would be advisable to secure the best and the latest designs from foreign countries suitable to our own requirements or adapted to our conditions and to secure the relative rights on a commercial basis for the establishment of a heavy machinery industry within the country. It should, however, be our objective to develop the technique of designing even from the initial stages and for this purpose, all such enterprises may require Government assistance for reasons stated.

CHAPTER—IV

GROUPING OF MANUFACTURE

Note :—In this Chapter the Panel has grouped the various lines of manufacture for building up the Heavy Machinery industry and also grouped the ancillary products industry needed.

29. Preliminary Remarks :

It will be evident from an examination of the various types of plant equipment and machinery required in the several important industries in India (vide Appendix IV hereto), that it would not be conducive to the growth of a heavy machinery industry for each and every industry to set up an organisation to produce its own requirements of machinery. If each particular industry seeks to design and construct its own machinery, it might lead to wasteful duplication of plant and equipment, over-capitalisation and higher costs of production. Such an organisation might also be less flexible for adaptation to newer industrial technique and to new lines of manufacture. Although, as a short term policy manufacture in this way may have to be undertaken for the purpose of meeting the immediate requirements of a particular industry, as a long term programme it might be unsound both technically and economically.

In the case of certain well-established industries requiring large quantities of machines of a like nature, separate units of manufacture might be justified. But otherwise it is desirable to combine the manufacture of several different types of machinery with similar characteristics in the same units, thus securing economy in production in technical processes, and a balanced flow of work. The modern tendency in highly industrial countries is towards specialisation in three directions, (i) ancillary products in general use; (ii) specialised products with widespread application and (iii) distinctive products for particular use. The aim should be to establish a rationalised industrial structure that will lead to an appropriate balance between the foregoing categories of manufacture in themselves, as well as being equated to the ultimate demand.

The industrial plant and machinery used and required by various important industries (vide Appendix IV here to) has been re-grouped under certain broad categories in Appendix VI hereto which tentatively suggests the units that would be necessary for its manufacture. A subject with such wide implications, can however, be dealt with only on the broadest lines since the actual decisions as which machines will be manufactured and where they will be manufactured must depend very largely on measures taken by private enterprise, augmented possibly by Government assistance in special cases.

It is necessary to emphasise that, for the establishment and growth of a heavy machinery industry, certain ancillary industries will also have to be developed, where from the secondary products required for machinery manufacture can be obtained. The establishment of such ancillary industries will increase the productive capacity of

primary industries, reduce the costs of production, and ultimately benefit the consumer.

The following paragraphs, 30 and 31) outline the suggested grouping of manufacture and give a rough approximate estimate of the value of the probable demand.

30. Grouping for Manufacture of main products:

(a) *Excavating Machinery:*

The machinery included under this heading is required for mining of materials for various industries such as the Mining Industry, the Chemical Industries, the Cement Industry, the Refractory, Brick and Tile Manufacturing Industry, the Glass Manufacturing Industry and generally all Metallurgical Industries. There is also some demand in the Civil Engineering Industry.

The machinery is generally subject to heavy stresses and rough use. It is utilised in out of the way places where immediate servicing is often not possible, hence it must be reliable and durable. It must also be portable. The technique of construction and design is of high order. Heavy Iron and Steel castings and in certain cases, steel forgings, are required for its construction. Initially the power units will have to be obtained from abroad and latter from other factories in India specialising in the manufacture of Prime Movers.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
*Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	36	66
*Yearly production target for the first five years stage of the development plan.	12	22

(b) *Hoisting Machinery:*

This machinery is in wide use in all industries where mechanical handling is employed. With improvement in the standard of living and in wages of labour, more of this machinery would be required. There is a large demand for this machinery in all metallurgical and heavy industries such as Mining, Chemical, Paper and Pulp, Textile, Cement, Refractory and Clay products, as well as Civil Engineering Industries.

The machinery sizes and designs vary from the simplest to the heaviest and most complicated types of construction. It is usually subject to high stresses, and rough use and often has to operate in out of the way places where skilled servicing is not readily available. The machinery has, therefore, to be of heavy and rigid construction. The technique of design and construction is of high order. Heavy iron

* These and other estimates in the subsequent pages are approximate. Similar estimates for the pre-war period are given for comparison in Table—2.

and steel castings and forgings are required for its construction. The power unit varies according to the type of service rendered and may be anything from a small air motor to the heaviest type of construction requiring high precision.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	47	86
Yearly production target for the first five years stage of the development programme.	24	43

(c) *Transportation Machinery :*

This type of machinery does not come under the purview of this Panel.

(d) *Conveying Machinery :*

This is common equipment widely in service, throughout the industrial field. There is a type of conveying machinery for each specific type of work. This equipment enhances efficiency in most industries.

The main function of this equipment is to convey raw materials and semi-finished products through the several stages of production eventually leading the finished products to storage or packing section or to trucks, wagons, or ships as the case may be. Although the design varies with the type of work, the construction technique is common. Since multiplicity of products is required to make up a conveyor system, it is possible to apply modern methods of line production and a wide use of single purposes machines. The technique of manufacture is not complicated, but close machine tolerances are necessary in particular cases.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	44	80
Yearly production target for the first five years stage of the development programme.	29	53

(e) *Crushing Machinery :*

This machinery is used to crush material into small sizes either for convenience of handling or as a first step in processing.

This type of machinery is in common use in the Mining, Chemical, Glass, Ceramic, Refractory and Cement Industries as well as Metallurgical Industries, and Civil Engineering Industries. Special types of crushers are used for crushing sugar cane in the Sugar Industries and wood chips in the Paper and Pulp Industries. The machinery is generally of massive construction since high stresses are involved. The construction and designs involved are of a high order. Heavy iron and steel castings are required in the construction of this machinery, and high manganese cast steels are required for jaws or liners subject to abrasive wear. Initially power units would have to be obtained from abroad and later from factories in India specialising in the production of Prime Movers.

Value in lakhs of
rupees at

1935-36 index	1944-45 index
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Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.

58 106

Yearly production target for the first five years stage of the development programme.

29 53

(f) *Grinding and Disintegrating Machinery:*

The machinery is in common use in several industries such as the Chemical, Cement, Glass, Refractory, Brick and Tile Industries and Metallurgical Industries. For the manufacture of mechanical pulp, a particular type of this machinery is also in demand. This machinery requires high grade designs and first class technique in construction. Iron and Steel castings are required for the construction of this machinery.

Value in lakhs of
rupees at

1935-36 index	1944-45 index
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Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.

46 84

Yearly production target for the first five years stage of the development programme.

23 42

(g) *Grading and Screening Machinery:*

This machinery is subdivisible into three different categories depending upon the type of work, but there is a similarity in design and construction, whether it be for grading or separation of solids from solids, or for separation of solids from liquids or solids from gases. This

equipment is in wide use in several industries including the Chemical Industry as also in the Metallurgical, Cement, Mining, Sugar, Pulp and Paper and Textile Industries. This machinery is generally of simple construction but involves a high technique of design. The stresses involved are not high and tolerances required are not too close. Iron castings or structural frames would be necessary for construction. Varieties of screening grids are essential for the construction of this equipment and machinery.

Where separation of solids from liquids is to be effected, tanks and vessels, and particularly a variety of filters are used.

For removing of dust particles and separation gases, tower type of structures such as cyclones, cell filters, absorbers and scrubbers are in common use.

This equipment although involving specialised design, can be easily manufactured in the country.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	58	106
Yearly production target for the first five years stage of the development programme.	39	53

(h) *Agitators and Mixers :*

This type of equipment is in general use in the Chemical Industry as also the Cement and other Ceramic Industries, and the Paper and Pulp and Soap Industries.

This machinery is of simple construction and design and should not offer any difficulty for manufacture. Materials of construction are iron and steel except where chemical action requires other types of materials. Several types of vessels either cast or fabricated would be also required.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	25	46
Yearly production target for the first five years stage of the development programme.	17	31

(i) *Tanks, and Storage Vessels:*

This category of equipment can be divided generally into three groups, viz., (i) for operations involving little or no pressure; (ii) for high pressure operations and (iii) for special operations where there is chemical action.

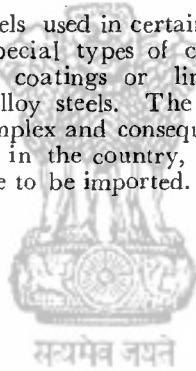
This equipment is in general use in many industries. The sizes vary according to the particular kind of work performed.

In most cases, the construction and design involved is simple and welded or riveted construction can be used. This simple type of construction can meet the greater part of the requirements of several industries such as Sugar, Paper Pulp and Chemical Industries.

The materials required for construction are mainly iron and steel, the major portion involving fabrication of plates.

For high pressure work, the design and construction technique required are of a high order, and special types of materials are, in certain cases required. Some of these materials are at present manufactured in sufficient quantities in India; others may have to be imported.

Tanks and storage vessels used in certain chemical manufacturing industries often require special types of construction, involving the application of protective coatings or linings and, in particular cases, the use of special alloy steels. The design and construction technique are not very complex and consequently manufacture can be satisfactorily undertaken in the country, although in some cases certain materials may have to be imported.



Value in lakhs of
rupees at

1935-36 index	1944-45 index
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Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.

65 118

Yearly production target for the first five years stage of the development programme.

49 89

(j) *Weighing and Proportioning Machinery:*

This machinery is in general use in various industries such as the Chemical, Cement, Glass and Metallurgical Industries. The construction and design technique involved are, on the whole, simple. Close tolerances are necessary in certain types to ensure accurate weighing and proportioning. The materials of construc-

tion required are mainly iron and steel. The manufacture of this equipment can be undertaken in this country.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	18	33
Yearly production target for the first five years stage of the development programme.	14	25

(k) *Drying Equipment :*

In the Chemical Industry, Paper and Pulp Industry, Soap Industry, Sugar Industry and the Textile Industry, this equipment is in wide use. The type of equipment required varies with the process. This machinery does not involve a high technique of design and construction. Most designs are of the drum or tower type. The materials of construction vary with the material to be dried, but is mainly iron and steel. This type of machinery can be manufactured in India.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development plan.	27	49
Yearly production target for the first five years stage of the development programme.	20	36

(l) *Pressing Machinery :*

This type of machinery is in common use in several industries. For metal forming, punching and deep drawing as also bale pressing, heavy types of this machinery are required. The designs and construction of pressing machinery are of a high order and vary widely according to the work to be performed. Iron and steel form the major portion of materials of construction.

Owing to the varying standards and technique of construction involved in the manufacture of these presses, and with the limited demand for a few particular types, only a part of India's require-

ments can be manufactured in the country in the immediate future. Expansion of production to cover the whole field may have to await further industrial development.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	41	75
Yearly production target for the first five years stage of the development programme.	14	25

(m) *Extruding, Rolling and Drawing Machinery:*

The principal demand for this machinery is from the Metallurgical Industry. There is also some demand in other industries such as in the Refractory Brick and Tile manufactures, Sugar mills and Oil Mills. The major portion of machinery so required is of heavy construction involving a high degree of technique.

The manufacture in India of the heavier types of this machinery would not be economical in the present stage of Industrial development.

(n) *Bleaching, Boiling and Washing Machinery:*

The demand for this machinery is mostly limited to the chemical processes of the Pulp and Paper Industry and the Textile Industry. The construction and designs involved are simple. The materials required for construction are iron and steel. The demand is varied but due to simplicity of design and construction, the manufacture of this type of machinery can be conveniently taken up in India as an early measure.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five-years stage of the development programme.	40	73
Yearly production target for the first five years stage of the development programme.	20	36
(o) Propelling and Pumping Machinery.	}	Under consideration by other Panels.
(p) Heat Exchangers.		
(q) Prime Movers.		
(r) Tractors (Power Units only).		

(s) *Cutting and Shredding Machinery :*

This machinery is in demand in the Pulp and Paper Industry and the Sugar Industry and to some extent, in the finishing side of the Textile Industry. In spite of the limited demand for this type of machinery the simplicity of design and construction involved make it desirable for its manufacture to be undertaken in India as an early measure. The materials required for construction are mainly iron and steel.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	27	49
Yearly production target for the first five-years stage of the development programme.	14	25

(t) *Textile Machinery (Preparation Machinery).*

This type of machinery is in demand in the various textile industries where textile fabrics are prepared for drawing, roving and spinning. Its manufacture involves special design and construction technique. The machinery is generally bulky and heavy and involves construction to close tolerances. The materials required for construction are mainly iron and steel. Although the demand for this type of machinery is limited to the textile industry alone, it is large enough to justify the manufacture of this machinery to be undertaken in India as an early measure.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	82	149
Yearly production target for the first five years stage of the development programme.	41	75

(u) *Textile Machinery (Spinning).*

The demand for this machinery is limited to the textile industry, but the requirements are large. Owing to the high speed of operation inherent in this type of machinery and the close tolerances to be maintained in its construction, special technique is involved in its manufacture. The materials required for construction are mainly iron and steel. In spite of the complexities in the manufacture of

this type of machinery, the demand makes it desirable that its manufacture should be taken up in India as an early measure.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	200	364
Yearly production target for the first five years stage of the development programme.	100	182

(v) *Textile Machinery (Weaving).*

This machinery is in demand only in the textile industry, but the demand is large. The design technique involved is complicated with several types of machinery and involves working to close tolerances in many cases. The materials of construction required are mainly iron and steel. Since the demand for this machinery is high, its manufacture should be taken up in India as an early measure.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	100	182
Yearly production target for the first five years stage of the development programme.	50	91

(w) *Textile Shuttles:*

These products are required in very large quantities in the weaving industry. Their design is standardised and they can be manufactured in India according to modern production methods.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five-years stage of the development programme.	20	36
Yearly production target for the first five years stage of the development programme.	13	24

(x) Textile Bobbins:

These are also required in very large quantities in the spinning and weaving industries. The design and size are standardised and they can be manufactured in India according to modern production methods.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	55	100
Yearly production target for the first five years stage of the development programme.	36	61

(y) Textile Machinery (Finishing).

This machinery is in demand in the textile industry only. The demand is limited and there are several varieties. The standard of designs and technique of construction, involving manufacture to close tolerances coupled with limited demand and varieties of design, seem to make it inadvisable to taking up the manufacture of this machinery immediately.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvements etc. on implementation of the first five years stage of the development programme.	15	27
Yearly production target for the first five years stage of the development programme.	Nil.	Nil.

(z) Special Types of Machinery:

In certain industries such as the glassware manufacturing industry highly specialised types of machinery are required. Due to the limited demand and complicated design and construction technique involved, it will not be economical to take up manufacture of these types of machinery for some years to come.

(ax) Agricultural Machinery:

Despite India being predominantly an agricultural country, there is very little agricultural machinery in use and the immediate demand is uncertain. As a long term policy and for reasons of self sufficiency, the manufacture of this machinery should be taken up, although it might not be an economic proposition for some years to come. The machinery involved is generally of simple design with easy tolerances

of construction. With the development of manufacture, in India, of the power units required for this machinery, the production of this type of machinery would become simpler. In the initial stages, certain types of this machinery such as ploughs, drills, and harvesting machinery should be taken up for manufacture, preferably either for animal draft or tractor draft, so as to avoid the complications of built in power units. Manufacture of tractors is the subject matter of another Panel.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvement etc. on implementation of the first five years stage of the development programme.	33	60
Yearly production target for the first five years stage of the development programme.	16	30

(ay) *Boot and Shoe Manufacturing Machinery:*

The manufacture of this machinery involves special types of design and construction. The demand is likely to be limited for some years to come. It may not be economical for the present to take up the manufacture of this machinery in India.

	Value in lakhs of rupees at	
	1935-36 index	1944-45 index
Probable annual demand for replacements and improvement etc. on implementation of the first five years stage of the development programme.	11	20
Yearly production target for the first five years stage of the development programme.	Nil	Nil

30A (az) *Summary.*

Demands estimated and production targets recommended for manufacture on implementation of the first five years stage of the development programme.

Value in lakhs of rupees
at 1944-45 index

	Estimated Demand.	Production target recommended (first five years period)
Grouped Products of Manufacture.		
(a) Excavating Machinery. ...	66	22
(b) Hoisting Machinery. ...	86	43
(c) Conveying Machinery ...	80	53
(e) Crushing Machinery. ...	106	53
(f) Grinding and Disintegrating Machinery ...	84	42
(g) Grading and Screening Machinery	106	53
(h) Agitators and Mixers ...	46	31
(i) Tanks and Storage Vessels ...	118	89
(j) Weighing and Proportioning Machinery ...	33	25
(k) Drying Equipment ...	49	36
(l) Pressing Machinery ...	75	25
(n) Bleaching, boiling and washing Machinery ...	73	36
(s) Cutting and Shredding Machinery	49	25
(t) Textile Machinery (Preparation Machinery) ...	149	75
(u) Textile Machinery (Spinning) ...	364	182
(v) Textile Machinery (Weaving) ...	182	91
(w) Textile Shuttles ...	36	24
(x) Textile Bobbins ...	100	66
(y) Textile Machinery (Finishing) ...	27	Nil
(ax) Agricultural Machinery ...	60	30
(ay) Boot and shoe Manufacturing Machinery ...	20	Nil
	1909	1001
	Say 20 Crores.	Say 10 Crores.
(z) Special type of Machinery	6 Crores.	Nil
Total.	26 Crores.	10 Crores.
Other Products of Manufacture.		
Special type of plant and machinery not included in the above groups.	6 Crores.	Nil
Total.	26 Crores.	10 Crores.

31. Grouping for Manufacture of Ancillary Products.

In the following paras we suggest the manufacture of certain ancillary products necessary for the Heavy Plant and Machinery Industry in India. Except for the Ordnance Factories and a few private workshops, there is no organised manufacture of such ancillary products in India. Specialised manufacture of basic, semi-finished and secondary materials is the foundation for a heavy engineering industry. Iron and steel are basic materials required in large quantities and non-ferrous alloys would also be necessary to a limited extent. The Major portion of iron and steel would be in the form of rolled sections such as plates, bars and other structural shapes, or in the form of semi-finished products like castings and forgings. Most of the non-ferrous alloys would be in the form of fittings, bars or tubes for use where iron and steel are not suitable. The maintenance of high quality standards is essential in the manufacture of these ancillary products.

(a) *Rolled Shapes:*

These are products of steel making and re-rolling mills and would be available in sufficient quantities for the requirements of machinery manufacture provided the programme of expansion of the steel industry is implemented without delay.

(b) *Iron and Steel Castings.*

(i) Reference has already been made to the present condition and deficiencies of iron foundries in India. For industrial expansion it will be necessary to improve the quality of castings by modernizing foundry practice throughout the country and expanding capacity in step with industrial development. Each foundry should be well equipped with all modern appliances and labour saving devices, and should also have a first class laboratory attached to it.

(ii) There are very few steel foundries in India and there is immediate scope for expansion. Expansion must, however, be carried out on modern lines which necessitates foundries being furnishing with adequate sand conditioning plant, equipment for process control and supplied with good quality sands.

(c) *Forgings:*

There is at present considerable capacity in the country, for the production of forgings and their heat treatment, but since this capacity is mainly in Ordnance Factories, it would be advisable to foster its development in civil firms.

(d) *Welded, Riveted and Structural Products:*

The demand for these types of products would be fairly large in manufacture of heavy machinery, but it would be inadvisable to start independent units for the present. It would be preferable to combine this kind of work with the manufacture of the plant and machinery of which it forms an integral part.

(e) *Formed and Deep-drawn Products.*

With the development of machinery manufacture, there will be a large demand for these products. During the early stages of de-

velopment, however, these should be produced as an adjunct of one or more of the major manufacturing units, where the bulk of the products would be consumed. The automobile and wagon construction industries, as examples, would be units where this activity could suitably be undertaken.

(f) *Die casting :*

Die castings will also be required for the manufacture of certain kinds of fittings, instrument cases and small complicated machine parts. Although there is no immediate demand for these products in large quantities, the demand will increase as machinery manufacture develops, and the necessity of establishing a die casting industry should not be ignored.

(g) *Tubes :*

The demand for these products is already of sufficient magnitude to justify the establishment of a tube making industry. So far there is no such manufacture and as industries develop, requiring more and more power machinery such as boiler plants, and heat exchangers the demand for tubes will increase. It is, therefore, necessary that this industry should be established as an early measure. The location of the industry should be close to a steel mill where from high grade steel billets can be obtained. A portion of these tubes has to be in a variety of forms such as coils, special bends etc. Associated industries to undertake the forming of tubes will have to be established as a secondary industry and this industry might be associated with industries manufacturing heat exchangers or other power plant machinery such as boilers.

(h) *Cold-Rolled Bar:*

Reference has already been made to this. The demand for this material will be extensive. It is not manufactured at present in India and manufacture should be established as an early measure preferably in a unit attached to one of the steel mills.

(i) *Gearing.*

There is no organised manufacture of this product in India. Various types and sizes of gears in large quantities are required for machinery manufacture. They vary from the simplest of small size cast iron gears to heavy duty and high speed special alloy steel gears. Gear is fundamental in industry. Design and manufacture of gears, gear trains, the reduction gearing is a highly specialised art. The demand for these products is sufficiently high to warrant the early establishment of the industry in India.

(j) *Bolts, Screws, and Screw Fastenings:*

Varieties of bolts, screws and screw fastenings are required for industrial plant and machinery manufacture in India. The manufacture of these parts is limited at present to only a few industries catering

mostly to their own needs. So far as the Panel is aware, no firm in India manufactures bright hexagon nuts, bolts and set-screws which are most important in the construction of high class machinery. Black nuts and bolts are manufactured in the country, but these are not suitable for building into high class machinery. There is sufficient demand in India for these products to justify the immediate establishment of this manufacture.

(k) *Springs:*

A few concerns in India manufacture springs in a variety of types of sizes. The quality of the springs produced is, however, far below the standards of imported springs. This may not altogether be the fault of the manufacturers since steel wire and spring steel of the requisite quality was not easily obtainable during war. Different qualities of steel, and different types of springs require different tempering processes. High grade springs are essential for the manufacture of heavy machinery. If the necessary facilities and encouragement are given, it is considered that indigenous spring manufacturers should be able to cater for all requirements.

(l) *Axles, Shafts, Spindles and Crank Shafts etc.*

No firms in India specialise in this type of work although these products are being turned out in certain shops as job work. Manufacture of these machinery parts requires first class rolled sections or forgings, in plain or alloy steels, special heat treatment, and machining operations to close tolerances. In particular cases, dynamic balancing of component parts is necessary. The demand for these products will develop with the growth of machinery manufacture within the country, and it is considered that the establishment of the industry is justified.

(m) *Bearings.*

There is no organised manufacture of these products in India. Broadly, there are two types of bearings, (a) plain bearings and (b) frictionless bearings. i.e., ball or roller bearings. The manufacture of plain bearings does not present great difficulties. The manufacture of ball and roller bearings involves highly specialised technique, the use of highly specialised machinery and the supply of high grade raw material. It is doubtful whether, at this stage of industrial development in India, it would be an economic proposition to establish a ball and roller bearing industry in the country. The need for establishing this industry should not, however, be ignored as a long-term measure.

(n) *Tools, Gauges, Dies, Jigs, and Templates etc.*

There is no particular firms in India specialising in the manufacture of these important products. The Ordnance Factories have a first class organisation and well equipped tool rooms, for the manufacture of these products. One or two organisations such as the one at Cossipore require to be established immediately in India to meet current requirements. Such organisations should be capable of manufacturing wide varieties of these products in large quantities. Machin-

ing and finishing to special tolerance limits and heat treatment require a high order of technique.

(o) *Misc. Machine Parts (Couplings, Clutches, Brakes, Keys, Cotters, Pins Pulleys, Flywheels etc.,)*

There is no organised manufacture in India for making these various kinds of machine parts so widely in demand in the machinery manufacturing industry. The work involved calls for manufacture of various sizes of parts to very close tolerances and in some cases heat treatment is also necessary. In the beginning, one or two units for the manufacture of these machine parts should be established to facilitate and aid the establishment of machinery manufacture in India. The plant can be located anywhere provided high grade technical staff and skilled workmen can be obtained in the locality.

(p) *Valves, Fittings and Instruments:*

There is no organised manufacture of these products in India, apart from a few varieties of small size valves and fittings. Unfortunately, the quality of indigenous products is not up to the standards of imported products. The operation of plant and machinery is largely dependent upon the accuracy and reliability of service performed by these fittings and instruments. The design and construction technique involved are of a high order, but if indigenous standards are improved there should not be any insuperable difficulty in the manufacture in India, a substantial portion of the country's requirements.



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(CHAPTER V.)

FURTHER CONSIDERATION OF CERTAIN PRINCIPAL ISSUES INVOLVED.

Note:—In this chapter the Panel considers some of the principal issues involved in the establishment and growth of a heavy machinery industry.

32. Statistics:

We have already indicated earlier in the Report, that the statistical data maintained by the Government or available otherwise are inadequate for a proper appreciation of the question of machinery manufacture. The classifications in the Government publications are too wide to permit a detailed analysis of the specific categories of demands and of market conditions. To enable a proper analysis to be made, it is necessary that the import figures should be presented under specific categories of plant, equipment and machinery. The statistical tables should also include figures of quantities as well as of the approximate sizes where possible, in addition to the values. Efforts should be made to determine the annual price index figures for plant and machinery. All this will require the establishment of a Bureau of Statistics for compiling and collating statistical materials and presenting them in an intelligible form. Immediate action should be taken in this matter.

33. Designs and Patents

This question has also been dealt with at some length since the importance of having approved designs and specifications for various types of machinery can hardly be over-emphasised. India does not possess, as yet, many fully experienced designers with the requisite technical knowledge in different lines of machinery manufacture.

Consequently, the best way to develop the industry is for Indian firms to enter into some kind of arrangement or agreement with foreign manufacturers whereby they would be supplied with the necessary designs, specifications and patent rights. In this matter, the Government can render useful assistance through Trade Commissioners abroad, and the Supply Missions in the U.K. and U.S.A.; by putting Indian industrialists in touch with foreign manufacturers of machinery and machine tools of the types required by India. It is necessary to stress that such co-operation should be entirely of commercial nature and the agreement should be a business proposition. Indian manufacturers should negotiate for the use of latest available designs and patents or arrange to manufacture foreign patented machinery on a basis of royalty or other suitable methods. Provision should definitely be made for a continuous supply to Indian manufacturers particulars of all new developments in respect of such manufacture of plant and machinery. It is absolutely essential that the financial control and management should remain predominantly in Indian hands. The technical assistance of experts and specialists from abroad for developing

machinery manufacture will, of course, be essential and they should be brought out on a contract basis while measures should be adopted for training Indian technicians and specialists in the different lines of manufacture.

34. **Standardisation and issue of Certificates.**

Standards of measurements and testing in respect of materials and manufacture are basic to the development of a machinery industry. It is necessary therefore that there should be specific standards for manufacture and inspection and for certificates of proficiency. The necessary technical organisation should be established, preferably under Government auspices, in co-operation with the trade interests concerned. The organisation should lay down standards and specifications for materials, workmanship, tolerances and performance of machinery. We hope that the Indian Standards Institution recently established will lead to the evolution of proper Standards applicable to all engineering products. (Reference is invited to para 7 (g) of this report.)

35. **Capital Goods.**

In para 30 (az) of this Report we have summarised yearly production target values of plant and machinery on implementation of the first five years stage of the development programme as Rs. 10 crores on the 1944-45 index of values.

On the basis that to manufacture machinery of the value of Rs. 1.0 lakh per annum, an initial capital investment of Rs. 1.6 lakhs is necessary and that of this amount 50% represents the value of machinery and tools, we assume that the value of capital goods required will be Rs. 8 crores initially.

Most of the capital goods necessary for the immediate development of machinery manufacture will, of course, have to be imported, since India is not yet manufacturing any substantial part of such machinery.

36. **Principal Raw Materials.**

The main raw materials required during the first five years stage of the development programme are as under:—

Iron	...	...	40,000 tons	per year
Steel	...	...	20,000 "	"
Non-ferrous alloys	...	...	5,000 "	"

Although certain of these materials will have to be supplied in a finished form, for example, tubes, ball bearings etc. and will thus have to be imported in the form of finished production, a major portion of the materials required can be produced in India.

Certain alloying elements such as nickel, chromium, tungsten, tin, zinc and some quantity of copper will have to be imported. The production of materials for the heavy machinery industry would require annually about 7,000 tons of such alloys.

37. **Lines of Development.**

The development of this industry will have to take place on a scientific and co-ordinated basis as possible. The industry is highly

technical and intimately correlated with the techniques of other industries producing consumers' goods. It will therefore have to be developed in close co-operation with other industries as well as existing engineering firms, so as to avoid wasteful competition and duplication of effort, which the country with its limited resources and a limited market cannot afford.

Some of the primary and ancillary units of manufacture for basic and secondary products which have to be established for the initial stages of development of machinery manufacture are considered in the Chapter IV of this Report. This list, is of course illustrative and not by any means exhaustive and will have to be modified as engineering data becomes available from abroad, as well as on the basis of an analysis of the programme of industrialisation eventually adopted by the Government of India. It would appear that most of the units of manufacture would be economically self supporting. There are certain industries which will require considerable development before they become economically self-supporting; such industries must not, however, be neglected if India is to have all-round industrial development, and Government assistance must be made available, where necessary, for the establishment of such industries.

38. Use of Ordnance Factories.

(i) In the early stages of development, there may be serious difficulties in procuring the necessary capital goods and technical aid. As already mentioned elsewhere in this Report, the equipment and technique available in the Ordnance Factories could be utilised, especially for manufacture of ancillary products. This would not only result in a saving in capital investment initially, but also avoid the delay which would occur if we have to await the import of all necessary machinery and equipment. The capacity of the Ordnance Factories and the exact manner in which it can render useful assistance to private enterprise for machinery manufacture should be properly ascertained. This is a subject which requires the immediate consideration of the Government in consultation with the interests concerned.

(ii) In connection with the use of Ordnance Factories as an aid to establishing a heavy engineering industry the Panel consider it necessary to sound a note of caution. The primary role of Ordnance Factories is to produce munitions of war. The menace of war cannot be entirely disregarded and so long as India maintains a Navy, Army and Air Force, so long must India's potential for the production of munitions of war so preserved. If therefore, Ordnance Factories become a corner-stone in the structure of the heavy engineering industry, it may happen that, should war occur and Ordnance Factories revert to their primary role, a serious gap will be left in the heavy engineering industry, at a time when it may be difficult, if not impossible, to fill this gap. Notwithstanding the big expansion in Ordnance Factories during World War II, India produces but a small proportion of the equipment necessary to maintain her

fighting forces, the balance being obtained by import. At the present time, India does not manufacture a single round of naval ammunition let alone torpedoes, naval guns and the many heavy engineering products necessary for the construction of naval craft. Similarly India does not manufacture tanks, heavy artillery and many other items of equipment required by the Army, or aircraft for the Air Force. Many of these items fall within the category of heavy engineering products; in fact to make India self-supporting in defence, Ordnance Factories need to be expanded rather than converted to civil use permanently. The ideal, of course, would be to so develop the civil industry that, in the event of war, the production of less essential items for industry could be curtailed, the capacity so released being geared to the production of munitions of war. This is the plan adopted in all highly developed countries. In the light of the foregoing, the Panel consider that the use of Ordnance Factories as an aid to the heavy engineering industry cannot be regarded as a permanent measure.

39. **Location of the Industry.**

The location of the heavy plant and machinery industry cannot be considered in the same light as the location of an industry with clearly defined boundaries such, for example, as the iron and steel industries where a few large and well organised units will meet the country's needs.

The heavy plant and machinery industry is of nation-wide importance and the needs of the country will undoubtedly require a nation-wide distribution of manufacturing resources. Furthermore, to ensure an early start in production, which is so essential to cope with outstanding demands for plant and machinery, it is evident that, initially at any rate, development of the industry will have to take the form of expansion of the several mechanical engineering works already established in the country, which already possess the managerial establishments necessary to negotiate agreements with foreign interests for the procurement of designs, on patent rights, etc., and a nucleus of the technical staff necessary to put production plants into operation.

As the main industrial plant of the country develops new units of manufacture will undoubtedly be required, particularly units for the manufacture of ancillary products such as seamless tubes, ball and roller bearings etc., essential not only to the heavy plant and machinery industry, but also to industry as a whole.

We consider that the main factors to be considered in locating new manufacturing units are,

- (i) Availability of land at cheap rates and with speedy possession. In this connection, we direct special attention to our remarks in para 8 regarding the development of industrial areas by Provincial-State Govts. and the installation of communications and public utility services.
- (ii) Availability of land for expansion.
- (iii) Rail communications with special facilities for the construction of sidings.

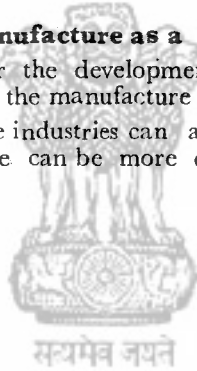
- (iv) Road communications.
- (v) Power supply at reasonably cheap rates.
- (vi) Water supplies at reasonably cheap rates.
- (vii) Availability of raw materials.
- (viii) Availability of labour. In this connection we direct special attention to our remarks in para 8 regarding the development of housing estates by Provincial-State Governments in areas adjacent to areas set aside for industrial development.
- (ix) Markets for finished products. Generally speaking it will be an advantage to produce plant and machinery near to the markets for finished products, but a balance must be preserved between this factor and other factors such as availability of raw materials, labour etc.

As a general principle we consider that, in establishing new industries, efforts should be made to avoid further congestion in the few industrial areas already developed, with the attendant evils of slum development, competition for labour, congestion of railway resources etc., etc.

40. Possibilities of Manufacture as a Cottage Industry.

There is little scope for the development of this industry as a cottage industry except for the manufacture of minor components.

To what extent cottage industries can assist in the development of machinery manufacture can be more definitely ascertained as this industry develops.



CHAPTER VI

41. **Conclusions and Recommendations.***(General Remarks)*

The Panel after considering all information placed before it by other bodies and the information collected by the Panel during the course of its investigations submits in this chapter its conclusions and recommendations. In submitting these conclusions and recommendations, we consider it necessary to point out that, in pursuing our investigations, we were faced with two main difficulties.

Firstly, for reasons stated in our Report, the Panel could not be furnished by Government with the target data which Government undertook to supply, vide para 2 of General Directive to Industrial Panels. (Reference : para 2 (i)*)

Secondly, owing to the wide field covered by the term "Plant and Machinery (Heavy)" which embraces the supply, in some form or other, of the means of production to practically every industry employing mechanical means of manufacture, the task of the Panel was much more complex than in the case of an industry with clearly defined boundaries.

Notwithstanding these difficulties we have endeavoured to cover the whole field of investigation, although this has necessitated the adoption of ad-hoc means of establishing a starting point for our work, as described in our Report. We consider the means adopted to be the best in the circumstances. We would, however, point out that the data given in our Report, particularly the figures of anticipated demands, is based largely on assumptions and forecast of development in other industries and may require considerable modification as the country's plan for general industrial development is implemented. If anything, we consider our estimates of future demands to be on the conservative side, having regard not only to India's needs, but also to the possibilities of export. We desire, however, that our conclusions and recommendations should be read in the light of the foregoing remarks.

Our conclusions and recommendations, which for uniformity, have been drafted generally in the order set out in para 3 of the General Directive to Industrial Panels, are as under:

- (1) *The scope and extent of development, including the type of products recommended.*

We consider that existing facilities for the manufacture of Plant and Machinery (Heavy) in the country are negligible and totally inadequate to meet the country's needs. There is great scope for the development of a heavy plant and machinery manufacturing industry and we consider that the development of this industry is of vital importance to the general industrial development of the country as a whole. (Reference: Para 6).

* Reference given in this page and succeeding pages are to paras of this Report.

A broad general description of the types of products, which it is recommended should be produced, is given in Appendix IV of our Report. Having regard, however, to the wide field covered by the term "Plant and Machinery (Heavy)" this list is not necessarily exhaustive.

(1-A) *The estimated requirements of capital goods together with such details of those requirements as may be available and how much should be imported from abroad.*

Since demands for plant and machinery will depend largely on the extent of the development of industries using such plant and machinery it is quite impossible to estimate, with any degree of accuracy, the requirements of capital goods for the Plant and Machinery Manufacturing Industry until the plan for the general industrial development of the country as a whole is framed.

Rough approximates of the rupee value of capital goods likely to be required, for the programme visualised by the Panel, together with an estimate of tonnage of iron, steel and non-ferrous alloys required are given in paras 35 and 36 of our Report.

(2) *Whether the industry should be under Government ownership either on grounds of national interest or because private capital is unlikely to take it up and if so whether it should be wholly or partly managed by Government.*

Owing to the wide field covered by the industry, and the need for developing the industries, step by step, in accordance with the general industrial development of the country, we do not consider that this industry as a whole can be established under State ownership, nor do we consider that State ownership is necessary in national interest.

We consider that private capital will be forthcoming for a well organised plan of general development, although State aid may be required vide Para 8 of our Report.

In certain specific cases, where the establishment of an ancillary industry may not be commercially remunerative, particularly in the early stages, State sponsorship with some measure of State management may be necessary. Examples of such industries are the establishment of a seamless tube manufacturing industry and a ball and roller bearing manufacturing industry. We would add that such industries are of importance not only to the plant and machinery manufacturing industry but also to the general industrial development of the country as a whole.

(3) *In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.*

For reasons explained in (1-A) above, it is impossible at this stage to estimate the capital required for the full development of the plant and machinery manufacturing industry. We are, however, of the opinion that such capital as is required will be forthcoming from public investment provided certain measures are introduced by Government, vide recommendations in sub-para (5) below, to safeguard the interests of this industry.

Notwithstanding the foregoing generalisation, capital assistance from Government may be necessary in certain cases, particularly in the matter of development of original designs, vide para 7 (b) of our Report and in the establishment of ancillary industries such as a seamless tube manufacturing industry and a ball and roller bearing manufacturing industry vide Para 31 of our Report.

(4) *The extent to which technical advice from abroad may be necessary.*

Considerable technical aid and advice from abroad will be necessary to establish plant and machinery manufacturing industry. Firstly, it will be necessary to engage the services of experts from abroad, qualified and experienced in design and production of industrial plant and machinery, and to continue to employ such experts until the art of design and the technique of production are well established in India. Secondly, it will be necessary to send suitable Indians for education and training in higher technical institutions and industrial plants and works abroad, particularly in the works of manufacturers entering into agreements with Indian industrialists for the manufacture in India, of proprietary types of industrial plant and machinery. (Reference: Paras 7 (d), (33).)

(4-A). *The availability and the future requirements of technical personnel so as to obtain a clearer indication of the present shortcomings and the future needs.*

It is impossible for this Panel, indeed we feel for any engineering Panel, to form even a rough approximate estimate of the technical personnel at present available for any particular industry since the priority of the competing demands of each industry for the available personnel can only be assessed after the general plan for industrial expansion has been framed. Such a plan can only be framed centrally, since it will be necessary to assess priority to the development of the various industries and to allocate the available personnel accordingly. We are, however, of the opinion that there will be a great shortage of technical personnel and we cannot stress too highly the need for the early implementation of plans for expanding training facilities in the country and for securing vacancies for Indians in training institutions abroad. As a very rough estimate, requirement of technical personnel for this plant and machinery manufacturing industry for the next five years may be taken as follows:—

					<i>For training abroad.</i>	<i>From train- ing institu- tions in the country.</i>
First year	...	...	...	...	100	200
Second year	...	...	...	...	100	200
Third year	...	...	...	...	100	200
Fourth year	...	...	...	...	150	300
Fifth year	...	...	...	...	150	300

We would emphasise that these are token figures put forward mainly with the object of securing "a place in the sun" in the matter of

technical training. The figures will be subject to modification and amendment as the industry develops.

(5) *The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.*

Design is the most important factor in the establishment of a heavy machinery industry in the country. It has been pointed out in the Report that it is not possible for a new concern to evolve fresh designs in the initial stages and consequently, it would be essential for Indian firms to obtain licenses on a Royalty basis from established and reputable manufacturers in U.K., U.S.A., Sweden, Switzerland, Germany, etc. Such arrangement would greatly facilitate the establishment of industries in that particular line in the country. As a rule, it might be desirable to have two or three factories for each of the products so as to ensure the achievement of quality and standards through competition. Indian manufacturers should be encouraged to obtain their licenses wherever possible from more than one country in order to ensure variety in the design of the product. The licensing arrangement should be such as would enable the licensee to obtain all relative technical information, drawings, fixtures, etc., of the latest designs from the licensors. The licensors should, when necessary, send their technical advisers to help in the establishment and operation of the factory in the initial stages. Arrangements should be made by the licensors to train technical personnel of the licensee in their factories abroad. For all this, the licensee should pay to the licensor an agreed Royalty on the sale of the product. It must be emphasised, however, that the control and management of the Indian Company must be entirely in the hands of the Indians and there should not be more than 25% of foreign capital in such a Company. It is expected that through some such arrangement foreign manufacturers, having their markets in India or those manufacturers desiring to establish their markets here, would get in touch with such manufacturers in India who want to establish factories here and assist in the starting of a heavy machinery manufacturing industry. The Panel is of the view that the national character of such an important industry should be maintained but technical and economic co-operation for its establishment would be necessary and should be facilitated by Government. (Reference: Paras 7, 8, 33).

(6) *The location of Industry.*

The Plant and Machinery Manufacturing Industry (Heavy) cannot be considered as a single industry with a definite location, or with two or three definite locations. The industry is of nation-wide importance and within certain limits its distribution must be nation-wide subject to certain over-riding considerations such as availability of raw materials, availability of labour, proximity of markets, availability of power, transport facilities and export facilities etc.

As regards the main products in large demand, it will generally be advisable that the production of plant and machinery to be located reasonably close to the users; for example, textile machinery produc-

tion might be located in textile producing areas. By following this principle transport costs for delivery of finished products will be reduced and also "service after sale" facilities will be more readily available.

In other cases where the demand is not large, location of the industry in association with a like industry may be advisable; for example, the manufacture of cement kiln shells could, with advantage, be associated with a works for the production of boilers and large pressure vessels.

In still other cases, where the demand is universal throughout the country, for example printing machinery, the location of the industry in relation to users is not a prime factor. Initially, we consider that the best course to follow in laying the foundations of the industry is to encourage the expansion of private firms already interested in the manufacture of plant and machinery.

Subject to the factors outlined above, we consider that a rational distribution of the industry, so planned as to avoid further congestion in the few main centres where industries are already established, with the attendant evils of over-crowding, slum development and uneconomic competition for available labour, is the best plan to adopt. A rational distribution of industry may necessitate the development of new industrial towns, suitably located in relation to transport facilities, sources of power supply etc. Advantage should be taken of this plan of development to improve the standards of housing of workers and related amenities such as schools, hospitals, recreational facilities etc. (Reference: Paras 8 (b), (39).

(7) *The nature of the assistance required from Government in the form of protective duties, bounties, research grant, expert advice, etc.*

We make the following recommendations under this head :

(a) **PROTECTIVE DUTIES.** We do not consider the imposition of protective duties to be the most suitable means of fostering the industry, since, so long as it is necessary to import the "means of production", the imposition of such duties will enhance the cost of imported goods and consequently retard general industrial development, with the consequential effect of restricting the development of the market for industrial plant and machinery.

(b) **BOUNTIES.** We consider that, in certain cases, the grant of bounties to manufacturers of industrial plant and machinery would be an advantage. This is a matter which might well be investigated further by the Board of Control proposed in para 8 (a) of our Report.

(c) **RESEARCH GRANTS.** We are definitely of the opinion that in certain cases, the award of research grants, together with financial assistance in the matter of construction of pilot plants, will foster the development of the industry. This is a matter which could also be dealt with by the Board of Control proposed in para 8 (a) of our Report.

(d) **EXPERT ADVICE.** The industry will require expert advice from abroad on technical matters and expert advice from Government as to the most suitable line of development for the heavy Plant and

Machinery Manufacturing Industry, having regard to the general plan for industrial development. Potential manufacturers of heavy plant and machinery should be advised by Government as to the types of plant likely to be required and of the measures which Government is prepared to introduce to foster the development of the industry. (Reference : Para 33).

(e) LICENSING. We consider that the development of the industry can best be fostered by the introduction of a system of licensing as proposed in para 8 (a) of our Report.

(f) TRANSPORT FACILITIES. In certain cases we consider that special transport facilities will be required to foster the development of the industry. These special transport facilities may apply to freight on raw materials or freight on finished products. Recommendations under this head could best be made by the Board referred to in Para 8 (a) of our Report.

(g) ACCELERATED DEPRECIATION ON BUILDINGS, PLANT, ETC. The customary rates of depreciation allowed on industrial plant and buildings is considered to be a serious handicap to the modernization of existing works and the establishment of new industries. One form of state aid, could, in this matter, take the form of accelerating depreciations for the purpose of taxation relief, at rates which would provide for writing off plant and buildings in say 10 to 16 years according to types.

(7-A). *The relative incidence of the import duty on the finished goods in comparison with the duty on the raw materials from which they can be manufactured.*

Although there may be a margin, favourable to raw materials, in the amount of duty imposed on imports, this margin does not always make it advantageous to import raw materials for the manufacture of finished goods instead of importing the finished articles. The main reason for this is that a considerable proportion of the raw materials often go to waste in the manufacturing process, with the result, that ultimately the total import duty has to be borne by 50% or even less of the tonnage of the raw materials imported. Generally speaking, we would favour abolition of import duties on raw materials. Although we appreciate that the raw material of one industry, for example alloy steels for the engineering industry, may be the finished article of another indigenous industry, in this case the steel industry, we would emphasise the importance of encouraging indigenous manufacturing industries by making available raw materials at the lowest possible costs.

(8) *If the industry is to be under private ownership and management what controls, if any, should be exercised by Government.*

We have touched on this subject in sub-para 3 above. If, on the one hand, industry is protected by Government either by tariffs, licensing or in any other way, we consider that, as a natural corollary, the interests of the users of plant and machinery should be protected by the establishment of a Board of Control vide Para 8 (a) of our Report.

(9) *What should be the organisation of the different units of the industry, e.g., should there be an Industrial Association? Would a cartel be desirable?*

The establishment of Association of Manufacturers of Plant and Machinery (Heavy), working in close collaboration with Government on the one hand and the users on the other, is recommended. The Association could nominate members to represent the interests of manufacturers of plant and machinery on the Board of Control and it would be convenient for Government to convey its views to manufacturers through the medium of such an Association. The Association could also deal with labour questions, industrial relations, research, etc.

(10) *The stages by which the industry should be developed.*

The development of the plant and machinery manufacturing industry must necessarily be kept in step with the demand for such plant and machinery. Since the industry is practically non-existent at present, and since there is so much leeway to be made good to meet even the present-day demands, there is great need for an early start to be made. The expansion of the industry to meet the evergrowing demand for industrial plant and machinery will undoubtedly take not less than 10 to 15 years. The drafting of the plan of development will involve the employment of experts vide Para 7(a) of our Report. We recommend the employments of such experts to draft a concrete plan for the first five years of development with tentative plans for the two successive stages of five years each.

(11) *Should the industry cater for the export market?*

We consider that the industry should cater for the export market, particularly the market in the Middle and Far East, where with the decline of Japan as an industrial nation, there should be great scope for export. In this connection the view held in some quarters is that, where an industry is assisted by Government, indigenous requirements should be met to the full before export is contemplated. In other words, manufacturers should not avail of Government assistance to develop export market. Taking a broad view, however, we cannot entirely associate ourselves with this principle. In fact, we would point to the example of Germany, Czechoslovakia etc., where, before the war, exports were subsidised for the purpose of developing the export trade. The export market is not a market which can be taken up as and when the producer chooses. Under normal conditions the export market requires intensive development, and we consider that, even in the early stages of the development of the plant and machinery manufacturing industry in India, steps should be taken to foster the export market by the allocation of small quota of India's products to the export market. Not only will such export help to bring the products of India prominently before foreign user but it will also secure for India the benefits of foreign exchange so necessary for the purchase of raw materials, foodstuffs, etc.

(12) *Should the industries be developed, as in Japan, on the cottage industry basis, if so to what extent?*

We do not consider that the industry offers scope for development as a cottage industry, except in the case of the manufacture of minor components.

42. **Conclusions and Recommendations**—(concl'd).

In addition to the recommendations made above, on the specific points laid down in the General Directive to Industrial Panels, we make the following recommendations:—

(1) **BUREAU OF STATISTICS**:—We cannot emphasise too strongly the importance of establishing, without delay, a Bureau of Statistics for the purpose of providing manufacturers with information in regard to imports etc. Such an organisation would be of value not only to the plant and machinery industry but also to manufacturers generally in India. (Reference: Para 2, 7(f), 32).

(2). **EDUCATION AND TRAINING OF TECHNICIANS, PARTICULARLY IN THE ARTS OF DESIGN**:—We represent most strongly the need for improving technical training institutions in the country, particularly in regard to the supply of the equipment necessary for training purposes and the need for associating technical training institutions with manufacturing institutions, as industry develops, so as to secure the necessary balance between theoretical and practical training. (Reference; Para 7(d)).

(3). **EDUCATION AND TRAINING OF ARTISANS**:—Of parallel importance to the training of technicians is the training of artisans. India lacks, to a large degree, the training facilities afforded by technical schools and such institutions in countries abroad. The average artisan, no matter how keen he may be to get on in the world, has few facilities for improving his lot, such as night schools where he can learn the elementary principles of design, machine drawing, and acquire such other technical education as is necessary to fit in for lower supervisory posts and, indeed, for advancement to managerial posts, should he prove his worth. We would direct attention to the need for the development of such technical training institutions as a matter of importance not only to the plant and machinery manufacturing industry, but to the engineering industry as a whole. (Reference: Para 7(e)).

(4). **STANDARDS AND TESTS**:—We emphasise the importance of laying down standards and tests. The industry cannot hope to gain the confidence of users of plant and machinery unless the products of the industry are manufactured to standards comparable in every way to the standards of imported plant and machinery. The acceptance of recognised standards is of even greater importance in the development of the export market where plant and machinery must sell on its merits without the aid of protection or licensing. In this connection we note with satisfaction that Government have established the Indian Standards Institution, and we trust that no delay will occur in implementing this plan. (Reference: Paras 7(g), 34).

(5) **IMPROVEMENT IN THE PRODUCTION OF IRON CASTINGS:**—We stress the importance of improving the production of iron castings, particularly having regard to the emphasis laid on this subject by Messers. Ford, Bacon and Davis Inc. in their Report. We recommend the employment of experts by Government to advise industrialists in the matter. (Reference: Para 19(e), 31(b)).

(6). **IMPROVEMENT AND EXPANSION OF IRON AND STEEL FOUNDRY:** The remarks against iron castings in sub-para above apply. (Reference; Para 19(f), 31(b)).

(7). **ANCILLARY INDUSTRIES:**—In our Report we have dealt at considerable length with the need for establishing ancillary industries in India. The establishment of such industries is essential, not only to the establishment of plant and machinery manufacturing industry, but to the engineering industry as a whole and to all users of mechanical means of production. We cannot stress too strongly the need for a seamless tube manufacturing industry, a ball and roller bearing manufacturing industry, along with many other ancillary industries set out in Appendix V of our Report. If further emphasis is required on this point, reference may be made to the Report of Messers. Ford, Bacon and Davis Inc. (Reference: Paras 19, 31).

(8). **LAND ACQUISITION:**—We cannot stress too strongly the need for speedy action on the part of Provincial Government in the matter of acquisition of land required for newly established industries and the expansion of the existing industries. (Reference: Para 8(b)).

(9). **POWER:**—Power requirements for the industry may not be high, but it is essential that such power as is required should be made available at reasonably cheap rates. Government assistance to this end may be necessary in certain cases. (Reference: Para 24).

(10). **WATER:**—The remarks against power apply equally in regard to the supply of water.

(11). **FOREIGN EXCHANGE:**—Facilities for foreign exchange should be made available to the industry in cases where it is necessary to purchase plant and machinery required from hard currency areas.

(12). **SHIPPING FACILITIES:**—Shipping facilities should be made available for the importation of plant and machinery necessary for developing the industry.

(13). **RAW MATERIALS:**—We consider it essential that raw materials should be made available to industrialists in India at prices reasonably comparable with prices in foreign countries. Government assistance may be necessary to this end. (Reference: Paras 8(d), 36).

14. **USE OF ORDNANCE FACTORIES:**—We consider that Ordnance Factories can be usefully employed in many directions to foster the establishment of a plant and machinery manufacturing industry in India. We would, however, emphasise the importance of regard-

ing ordnance factory aid as an interim measure only, and not as a final solution to the problem.

With regard to the use of Ordnance Factories, we consider that in making these facilities available, special consideration should be given by Government to ensure that the cost of the products supplied does not exceed the cost of the imported articles. Complaints have been made too often in the past that, consequent on the high overheads in Ordnance Factories, due to the staff and facilities maintained as an insurance against the War, the cost of Ordnance Factory products supplied to the trade is unreasonably high, so much so that in certain cases the use of these essential facilities has been placed beyond the reach of users on the ground of cost alone. We understand that a plan has been evolved for adjusting overheads and we trust that this plan will be carried into effect so as to ensure that such valuable facilities will not remain idle for purely financial reasons. (Reference: Paras 20, 38).

(15). **SETTING UP OF AN ORGANISATION FOR THE IMPLEMENTATION OF PANEL RECOMMENDATIONS:**—In conclusion we would represent to Government, in the strongest possible terms, the need for setting up an organisation to ensure that such recommendations as are made in this Report and accepted by the Government are duly implemented. We feel that this recommendation may apply, with equal force, to the work of many other Panels. Too often in the past have experts devoted time, thought and energy to the preparation of reports which, on the Committee or the Panel being dissolved are shelved. In this connection we welcome the establishment of the Advisory Planning Board and we trust that, notwithstanding the volume of work this body will undoubtedly be called upon to handle, this Board will see to it that suitable machinery is set up for co-ordination and implementation of the recommendations of this and other Panels at an early date.

43. **Appreciation:**—In submitting our Report, we desire to place on record our appreciation of the work of the Secretary, Mr. C. S. N. Raju. Starting with little available material or data as a basis for his work he had, by his industry and diligence and by the application of his technical knowledge and experience evolved valuable information that has enabled the Panel to compile a report which, in our view, represents a reasonable appreciation of the situation in regard to the steps to be taken to establish a Plant and Machinery (Heavy) Manufacturing Industry in India.

Sd. G.L. Mehta.

Chairman.

Members.

(i) D. B. Cooper.

(ii) M. H. Cox,

Brig.

(iii) P. F. S. Warren.

(iv) S. Moolgaoker.

(v) L. J. Barraclough.

(vi) S. L. Kirloskar.

(vi) K. K. Birla.

Secretary.

C. S. N. Raju.

APPENDIX—I

DEPARTMENT OF PLANNING AND DEVELOPMENT

General Directive to Industrial Panels

It is the function of panels to make recommendations to Government regarding the development of industries, both existing and new. These recommendations should be so framed as to enable Government to prepare a detailed phased plan for the five years following the cessation of hostilities, as the first stage of a 15-year plan of industrial development for the whole country.

2. In order to assist them to formulate recommendations, panels will be supplied, as far as possible, with factual information prepared by the panel secretaries. In the case of new industries, the information will consist of a general survey of the industry and the importance of starting it in India, the availability of raw material, the power requirements, the demands of the Indian markets and the probabilities of exports. In the case of existing industries, the information will naturally be more comprehensive ; it will indicate in addition, the location of existing units, the types of goods produced, the total production under each category and the assistance, if any, given by Government. These items are to be regarded as illustrative and not exhaustive.

Government will give each panel, as a basis, for discussion, the provisional target to be aimed at in the first five year period and, wherever possible, of the target to be reached in 15 years.

3. The recommendations of the panels should cover the following points :—

- (1) The scope and extent of development, including the type of products recommended.
- (1-A) The estimated requirements of capital goods together with such details of these requirements as may be available in India and how much should be imported from abroad.
- (2) Whether the industry should be under Government ownership either on grounds of national interest or because private capital is unlikely to take it up, and if so, whether it should be wholly or partly managed by Government.
- (3) In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.

- (4) The extent to which technical advice from abroad may be necessary.
 - (4-A) The availability and the future requirements of technical personnel so as to obtain a clearer indication of the present shortcomings and future needs.
 - (5) The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.
 - (6) The location of the industry.
 - (7) The nature of the assistance required from Government in the form of protective duties, bounties, research grant, expert advice, etc.
 - (7-A) The relative incidence of the import duty on the finished goods in comparison with the duty on the raw materials from which they can be manufactured.
 - (8) If the industry is to be under private ownership and management, what controls, if any, should be exercised by Government.
 - (9) What should be the organisation of the different units of the industry, e.g., should there be an industrial association? Would a cartel be desirable?
 - (10) The stages by which the industry should be developed.
 - (11) Should the industry cater for the export market?
 - (12) Should the industry be developed, as in Japan, on the cottage industry basis and, if so, to what extent?
4. Although, as stated above, the panels may recommend the grant of protection, it will not be their function to consider broad questions of international trade and commercial policy.
5. Joint meetings of the panels should be held, wherever necessary, to secure co-ordination particularly where the processes and the products of one industry are connected with those of another.
6. Some of the panels have been drawn broadly and it may be necessary to co-opt members for dealing with specific branches of the industry. Members may be co-opted by the Chairman in consultation with the Industrial Adviser.
7. Before submitting recommendations, panels should consult Provincial Industrial Committees, particularly in the matter of location of industry. They should also, where the circumstances of the case require it, consult industrial Committees in States or State Governments/Durbars. The recommendations should be submitted to Government through the Industrial Adviser.

APPENDIX II.
INDUSTRIAL PLANT & MACHINERY (HEAVY)
(Prominent Industries)

1. Agriculture
2. Ceramic and Refractory Industries.
 - (a) Brick & Tile Works
 - (b) Cement Mills
 - (c) Glass Works
3. Chemical industries
 - (a) Chemicals Manufacture
 - (b) Soap Works
4. Leather Industries
 - (a) Leather Tanning and Curing Works
 - (b) Boot and Shoe Manufacturing Works
5. Metal Working Industries
 - (a) Ferrous and Non-Ferrous Metallurgy
 - (b) Machine Tools (not included)
 - (c) Metal Working and Forming
6. Mining
7. Oil Crushing and Refining Works
8. Pulp and Paper Mills
9. Printing and Lithography
10. Rice and Flour Mills
11. Saw Mills and Wood Working
12. Sugar Mills
13. Tea Industry
14. Textile Industry (Cotton)
15. Textile Industry (Jute)
16. Textile Industry (Woollen and Worsted)
17. Textile Industry (Silk and Artificial Silks)
18. Transportation and Communications
 - (a) Rail Transport (Not included)
 - (b) Road Transport (Not included)
 - (c) Water Transport (Not included)
 - (d) Air Transport (Not included)
 - (e) Communications (Not included)

APPENDIX III.

Given below is the list of few firms, which, during the war period had taken up the manufacture of certain items of Industrial Plant & Machinery.

CALCUTTA :

1. Burn & Co., Calcutta.
2. Britannia Engineering Co. Ltd., Calcutta.
3. Textile Machinery Corporation Ltd., Calcutta.
4. Kumardhubi Engineering Works Ltd., Kumardhubi.
5. Jessops & Co. Ltd., Calcutta.
6. Jay Engineering Works, Calcutta.
7. India Machinery Co. Ltd., Calcutta.
8. G. T. R. Co., Dum Dum Calcutta.
9. Garden Reach Workshops, Calcutta.
10. James Alexander & Co., Calcutta.
11. Hooghly Docking & Engineering Co. Ltd., Calcutta.
12. Britannia Buildings & Iron Co. Ltd., Calcutta.

BOMBAY :

13. Richardson & Cruddas Ltd., Bombay.
14. Cooper Engineering Works Ltd., Satara.
15. Kirlosker Bros. Ltd., Kirloskerwadi, Satara.
16. Vasant Industrial and Engineering Works, Bombay.
17. Investa Machine Tools and Engineering Works, Ltd., Bombay.
18. Associated Cement Co., Bombay.
19. Jyoti Ltd., Baroda.

MADRAS :

20. P. S. G. and Sons, Coimbatore.

SIND :

21. Herman and Mohatta, Karachi.

APPENDIX IV.

[I. CHEMICAL INDUSTRIES PLANT AND MACHINERY]

Materials Handling : (a) locomotives, tractors, trucks, (b) grab bucket cranes, derrick cranes, bridge cranes ; (c) winches, car pullers, aerial ropeways, power hoists ; (d) loading and unloading machines ; (e) hydraulic and pneumatic conveyors, screw conveyors, belt conveyors, tray and bucket chain conveyors.

Crushers : (a) gyratory crushers ; (b) rotary crushers ; (c) jaw crushers ; (d) hammer crushers.

Grinders and Disintegrators : (a) pebble and ball mills, (b) tube and rod mills ; (c) ring and bowl mills.

Grading Equipment : (a) gyratory, rocker and vibratory screens ; (b) rotating screens ; (c) multigrader screens ; (d) pneumatic separators ; (e) hydraulic separators ; (f) electro-magnetic separators ; (g) magnetic induction and electrostatic separators.

Tanks and Storage : (a) low pressure (riveted and welded) tanks ; (b) high pressure gas tanks (forged and machined, high pressure design and construction) ; (c) chemical storage tanks requiring protective linings.

Weighing and Proportioning : (a) weighing platforms ; (b) measuring tanks ; (c) automatic proportioning weighers ; (d) proportioning pumps and automatic devices.

Propelling Machinery : (a) reciprocating pumps (plunger and piston type) ; (b) rotating pumps (centrifugal pumps, gear pumps) ; (c) air lifts and hydraulic or pneumatic ejectors ; (d) squeeze pumps ; (e) reciprocating compressors ; (f) centrifugal fans and blowers.

Agitators and Mixers : (a) mechanical agitators (propeller, paddle and screw type) ; (b) hydraulic and pneumatic agitators ; (c) mixing mills ; (d) blenders, pan mixers, etc.

Separators : (a) dust catchers and separators (gaseous), dry cyclones ; (ii) wet cyclones ; (iii) bag filters ; (iv) cell filters ; (v) gas scrubbers ; (vi) gas absorbers ; (b) clarifiers, sludge thickeners, decanter thickeners, washers flocculators ; (c) sand and gravel filters, pressure filters, suction filters ; (d) centrifugals (perforated and imperforated).

Crystalliser and Driers : (a) stationary and continuous crystallisers with agitators, and heating and evaporating coils ; (b) blakers, hot-air driers, spray driers, rotary driers, drum driers, tower driers, belt driers, vacuum driers.

Distilling and Fractioning : (a) batch stills and continuous stills ; (b) plate towers.

Evaporators : (a) single effect evaporators ; (b) multiple effect evaporators.

Vacuum Devices : (a) condensers ; (b) vacuum pumps ; (c) jet ejectors (hydraulic and steam).

Heater Exchangers and Refrigeration : (a) open type heaters ; (b) closed type heaters ; (c) kettles with heating or cooling coils ; (d) electric heaters ; (e) spray ponds and cooling towers ; (f) steam vapour refrigerators ; (g) other vapour refrigerators ; (h) humidification and dehumidification equipment.

High Pressure and Special Equipment: (a) welded solid wall vessels ; (b) multi layer and protective layer vessels ; (c) accumulators, receivers ; (d) hydraulic presses ; (e) moulding presses.

Power Machinery : (a) boilers with economisers and air heaters ; (b) steam engines and turbines ; (c) gas and oil engines ; (d) motors, D. C. generators and alternators.

[2. PULP AND PAPER MANUFACTURING MACHINERY]

Wood Preparation : (a) log haulups or jack ladders ; (b) cut-up mills ; (c) slashers ; (d) screens ; (e) conveyors ; (f) barking drums, (knife barkers, tumbling barrel barkers, stationary and intermittent barking drums) ; (g) bark presses ; (h) chippers and chip screens ; (i) chip crushers and rechippers ; (j) chip dryers ; (k) chip bins.

Mechanical Pulp Manufacture : (a) grinders, (hand feed grinders, pocket grinders, magazine grinders, special type grinders as Northern Grinder and Kamyrr Grinder) ; (b) hydraulic power feed equipment.

Sulphite Pulp Manufacture : (a) coolers (for manufacture of sulphite) ; (b) towers (for manufacture of sulphite) ; (c) acid storage tanks ; (d) digesters.

Alkaline Pulp Manufacture : (a) chip bins ; (b) liquor tanks ; (c) digesters ; (d) diffusers ; (e) stock chests ; (f) pulp washers ; (g) rotary smelting furnaces and heat recovery boilers ; (h) leaching tanks ; dissolving tanks and storage tanks, reaction tanks, filter presses ; (i) grading equipment ; gratings, screens, sand catchers (or riffing), centrifugal and rotary screens, deckers and thickeners ; (j) save-alls, filters, presses and lappers ; (k) drying machines, slitters, cutters and winders.

Rag and Other Fibre Pulps : (a) cutters, dusters, magnetic roll separators ; (b) cookers ; (c) washers.

Bleaching : (a) bleachers (Bellmen and Fletcher), high pressure and multi-stage bleachers ; (b) other bleaching equipment ; (c) equipment for washing bleached pulp ; (d) chlorine manufacture, storage and transportation equipment.

Pulp Preparation : (a) bale pulpers, breaking pulpers ; (b) beaters, refiners (jordans) ; (c) save alls, settling tanks, inclined screens, rotary screens etc. ; (d) stock chests with agitators ; (e) regulators.

Paper Making : (a) fourdrinier paper machine (flow boxes ; slices, deckle, the shakes rolls) ; (b) presses ; (c) dryers and smoothing rolls ; (d) calenders ; (e) reels, slitters and winders.

Paper Finishing : (a) sizing press ; (b) rewinder machine ; (c) cutter machine ; (d) layboys ; (e) supper calenders, sheet calenders and special calenders ; (f) plating machine ; (g) trimming machine ;

(h) ruling machine ; (i) colouring, coating, glazing and other finishing machines.

Power Machinery : (a) boilers, economisers and air heaters ; (b) engines and turbines ; (c) pumps—(stock pumps, water pumps and vacuum pumps) ; (d) condensers, coolers, heaters, evaporators, steam accumulators ; (e) motors and heaters ; (f) heating and ventilation plant.

[3A. TEXTILE PLANT & MACHINERY COTTON]

Preparation Machinery : (a) gin and press ; (i) roller gin ; (ii) saw gin ; (iii) cotton press ; (b) bale breaker and mixer ; (c) shirely analyser ; (d) opener with hopper feeder ; (e) scratcher and automatic feed regulators ; (f) lap machine ; (g) the flat revolving card ; (h) silver lap machine ; (i) the card grinder.

Spinning Machinery : (a) silver lap machine ; (b) ribbon lap machine ; (c) combing machine ; (d) drawing frame ; (e) slubbing frame ; (f) *spinning frame* ; (i) flyer threstle frame ; (ii) ring frame ; (iii) the mule ; (g) high draft roving and spinning frame ; (h) doubler machine or twiner.

Weaving Machinery : (a) gasing frame ; (b) bobbin winding frame ; (c) warping and beaming machine ; (d) sizing machine ; (e) *loom* : (i) plain ; (ii) automatic (Northrop loom ; Stafford loom ; Toyeda loom) ; (f) cloth folding machine.

Finishing, Dyeing and Printing : (a) shearing machine ; (b) singering machine ; (c) bleaching and boiling equipment etc. (for bleaching lime boiling—washing—souring—rewashing—soda boiling—washing—souring—rewashing—drying) ; (d) printing machine and drying machine ; (e) mercerizing machine.

[3B. TEXTILE PLANT AND MACHINERY (JUTE)]

Preparation : (a) bale press, bale opener, softening machine, root opener, root comber, snipping machine, breaker card, lap or balling machine, finisher card ; (b) waste cleaner, dust shaker, dust extractor, cazer card ; (c) emulsion mixer tank.

Spinning : Drawing and Roving Frames : push bar drawing frame, open link chain drawing frame, spiral drawing frame, rotary drawing frame, circular drawing frame, ring drawing frame, roving frame.

Weaving : (a) bobbin winding frame, warping and beaming machine ; sizing machine, plain loom and automatic loom.

Finishing : (a) cropping or cutting machines ; (b) damping, calendering or mangling and drying machines ; (c) bleaching, washing and drying machines ; (d) stretching, calendering and beetling machines ; (e) lapping, folding or plaiting machines ; (f) bag or sack cutting machines or frames ; (g) bag or sack sewing machines ; (h) bag or sack printing machines.

[3C. TEXTILE PLANT AND MACHINERY WOOLEN AND WORSTED]

Preparation : wool dusting machine, wool steeping machine, wool securing machine,—(fork or harrow, rocker, rake and conduit types) continuous dryer, self acting teaser or willow, beating machine, tenter—hook—willy, garnetting machine.

Carding: Automatic hopper feed, carding machine (scribbler, carder, condenser), self actor **gilling machine, combing machine** (for worsted).

Spinning: drawing machine, roving machine, spinning frame, (flyers ring and gay).

Weaving: warpers, sizers, beamers, handlooms and power looms.

3D. TEXTILE PLANT & MACHINERY (SILK)

(a) reeling machines ; (b) cleaning and winding machines ; (c) twisting or spinning machines ; (d) doubling and twisting machines ; (e) weaving machinery (see also cotton machinery) ; (f) reel winding machines, warp winding machines, weft winding machines, looms, sizing machine, gassing, calendering and stretching machinery, dyeing machines, printing machines, ribbon looms and knitting machines.

3E. TEXTILE PLANT & MACHINERY (RAYON)

Preparation: (a) steeping and pressing machines ; (b) kneading or disintegrating machines ; (c) dialysing tanks and machinery (Heibig Dialyser) ; (d) sulphuric acid drums ; (f) xanthite kneading and mixing machine ; (g) ripening tank ; (h) secondary mixers or blenders ; (i) filter presses, (pressure and vacuum type) ; (j) deaerators.

Spinning: (a) constant delivery pumps (gear wheel type, and piston or plunger type, single or multistage) ; (b) candle filters ; (c) centrifugal spinning machines ; (d) bobbin spinning machines ; (e) jets and jet measuring apparatus ; (f) other rayon spinning machines (cuprammonium, cellulose acetate and staple fibre).

Yarn Finishing (a) reeling machines ; (b) desulphurising, bleaching, souring and washing machines ; (c) stretching machines ; (d) tunnel drying machines ; (e) twisting machines.

Weaving : (a) reelers, throwers, doublers, bobbin winders, cone winders, warping and beaming machines, combination sizing hot air drying and beaming machines and quill winders ; (b) power looms, dobby looms, jacquard looms, and other automatic looms.

4. MINING MACHINERY

(a) **Excavating, Loading and Unloading Machinery :** (i) pillar crane ; (ii) jib crane ; (iii) bridge crane ; (iv) guy derrick ; (v) grab bucket crane ; (b) **Hoisting Machinery :** (i) winches ; (ii) car pullers ; (iii) steam electric and pneumatic power hoists and elevators ; (c) **Conveyor Machinery:** (i) mobile conveyors : (trucks, tractor, locomotives) ; (ii) continuous conveyors, belt conveyors ; (iii)

and bucket and chain conveyors, air driven haulage gear, endless ropehaulage gear and aerial ropeways ; (d) **Crushing Machinery** : gyratory crushers, rotary crushers, cone crushers, jaw crushers, hammer crushers ; (e) **Grading Machinery** : gyratory, rocker and vibratory screens, rotary screens, multigrader screens, hydraulic separators, electro-magnetic and electro-static and induction separators, other ore dressing machinery ; (f) **Dust Catchers** ; (g) **Storage Bins** ; (h) Weighing platforms, automatic proportioning weighers and loaders ; (k) **Power Machinery** : boilers, steam engines, turbines, gas engines, oil engines, motors (electric and pneumatic) pumps (reciprocating and centrifugal air lifts), air compressors, centrifugal fans and blowers, air conditioning and ventilation plant.

5. SUGAR MILL MACHINERY

Conveying : Cane conveyors and feeders ;

Extraction : (a) cane cutters, cane shredders ; (b) multiple roller crushing mills ; (c) maceration and remilling mills, bagasse washing tanks.

Clarification : (a) strainers, tank type clarifiers, dorr clarifiers ; (b) bag filters, cloth filters, sand filters, bagasse filters, filter presses and centrifugal subsider ; (c) storage tanks, sulphitation and carbonisation tanks.

Concentration and filtration : (a) heaters, evaporators, vacuum pans, crystallisers and centrifugals ; (b) dryers ; (c) sugar conveyors and loaders.

Power Plant Machinery : steam boilers, steam engines, steam turbines, condensers, steam heaters, air heaters, cooling towers, evaporators, air compressors, SO_2 and CO_2 compressors, vacuum pumps, centrifugal pumps and motors etc.

Sugar Refining : solution tanks, defectation pan, filters, vacuum pans, wet air vacuum pumps, condensers.

6. CEMENT MANUFACTURING MACHINERY

Mining and Materials Handling : (a) excavators and loaders, disc harrows, shovel excavators and ladder excavators ; (b) track conveyors, chain conveyors, belt conveyors, ropeways and bucket elevators, etc.

Crushing : gyratory crushers, jaw crushers, disc crushers, hammer crushers, and roll crushers.

Drying : rotary driers (such as Newell's drier and the Ruggles Coles drier).

Proportioning and Mixing : (a) automatic weighing machines ; (b) mixer machines.

Washing and Grinding : (a) modern wash mills ; (b) ball mills, tube mills, ring mills, collectors, etc., slurry separators, slurry pumps.

Burning and Cooling : (a) rotary kilns with automatic feed mechanism ; (b) rotary clinker coolers.

Packing: automatic cement packing machines.

Fuel Preparation and Burning: coal crushers, screw conveyors and pneumatic conveyors, and pulverised fuel burners.

Power Machinery: pumps, engines and motors, compressors, fans and blowers.

7. BRICK & TILE MAKING MACHINERY

Mining and Material Handling: (a) disc harrows, shovel excavators, ladder excavators, shale planers, drag line excavators, tractor and scoop; (b) tractor wagons, chain conveyors, belt conveyors, portable conveyors, mono rail conveyors, and aerial ropeways.

Crushing and Grinding: (a) hammer crushers, roll crushers, magnetic separators; (b) tempering mills, ball mills, pan mills, tube mills, and ring mills; (c) dust collectors; (d) shredding machines, plain rolls, fluted rolls, grooved rolls, toothed rolls, spiked rolls, wet grinding pans, and edge runner mill.

Blending and Mixing: (a) automatic weighing machinery; (b) mixing machinery, paddle conveyor and mixers, trough mixers, and triple shafted mixers (Erforuth).

Cleaning and Screening: (a) Bohrs clay cleaners; (b) autoclay cleaners, spiral rolls, conical rolls and perforated or slotted rolls; (c) inclined, vibratory and rotary screens.

Washing: wash mills, settling tanks, and slurry pumps.

Feeding: push plate feeders, apron feeders, spiral or screw feeders, chain feeders and rotary feeders.

Moulding: (a) Hand Moulding; pug mills, lever presses, toggle presses; (b) Machine Moulding of Plastic Materials; "Monorch" brick machine, "Norris" brick machine, Anglo-American brick machine, Martin auto brick machine, Eddington moulding machine, Berry's brick machine and Holes brick making machine; (c) Machine Moulding of Semi-plastic Material; conical or stopped barrel pug mills, (Gressman stepped barrel type, Jones short collar type and Whitaker long conical collar type brick machines) combination pug mills with mixers, feeders, dryers and crusher rolls in one to three stages; (d) Machines for Moulding of Stiff Plastic Materials; stiff plastic brick machines. (Bradley and Cravan manufacture; Jackson & sons manufacture; Dawson and Fawcett manufacture "New Era" brick machine and stiff plastic machines with incorporated clot mould and repress). (e) Machine Moulding of Semi Dry Materials, (Whitaker semi dry brick machine, "Fawcett" semi dry brick machine, "Sanspreil" semi dry brick machine, "Stanley" press, "Emperor" press and "Hercules" press). (f) special machines; Double piece brick machine, side delivery brick machine, and integral expression rolls brick machine).

Auger Brick Machines: auger brick making machines, combination auger brick making machines with feeders, mixers and roll grinders.

Brick Cutting Tables: fixed frame wire cutting table, travelling frame wire cutting table, rotary wire cutting table, power operated

cutting table (such as Jones and sons Ltd., manufacture, T.C. Fawett Ltd. Manufacture, Bennet and Sayer Ltd. manufacture) and automatic cutting table (such as Keller automatic cutting table with elevator).

Brick Drying: carrier dryers, proctor dryers, tunnel dryers, wolf dryers, car dryers, cars and mangles for receiving bricks from dryer.

Repressing: hand operated screw presses, friction driven presses power driven screw presses, eccentric represses, and direct drive represses.

Miscellaneous Machinery: Sanding machine, press for rustic bricks.

Power Machinery: Boilers, heaters, compressors, motors and engines.

(8). GLASS AND GLASSWARE MANUFACTURING MACHINERY.

Mining and Materials Handling: (a) disc harrows, shovel excavators, ladder excavators etc.; (b) track conveyors, chain conveyors, bucket or tray conveyors, belt conveyors and ropeways.

Cleaning, Washing and Drying: (a) magnetic separators; (b) wash mills; (c) dryer machines.

Crushing: (a) gyratory crushers, jaw crushers, disc crushers, hammer crushers and roll crushers etc.

Proportioning and Mixing: (a) automatic weighing machines; (b) mixer machines.

Grinding: (a) ball mills, tube mills and ring mills.

Dust Collectors etc: (a) cyclones; (b) dust collector machines; (c) bins.

Melting: (a) pot furnaces and tank furnaces; (b) gas producers.

Working Machinery: (a) casting machines; (b) plate glass rolling machinery and sheet forming machinery; (i) Bicherouz plate glass rolling machinery, (ii) Libbey—Owens—Colburn glass drawing machinery, (iii) Fourcault machines, (iv) wire glass forming machinery; (c) tube and rod drawing machinery; (Danner and Volls process tube and rod making machinery); (d) the bog feeder machines; (e) the automatic bottle making machines; (i) Owens automatic machines, (ii) Hartford empire machine, (iii) Miller mould pressing and blowing machine, (f) the Corning bulb machine and (g) continuous glass fibre drawing machine.

Annealing: The modern belt gas fired lehr.

Miscellaneous: flame cracking off and fire polishing machines, grinding, polishing and trimming machinery; frosting machines; (sand blast frosting machine and acid frosting machine).

Power Plant Machinery: boilers, fans, blowers, air compressors, vacuum pumps, hydraulic pumps, engines, motors.

9. SOAP WORKS MACHINERY.

Materials charging: Pumps, hoists, jib cranes.

Storage: Tanks, kettles, crutching machines.

Soap Slabbing: Improved champion slabber, automatic power slabber, hand operated cutting table, automatic power cutting and stamping table, cake cutter.

Chipped and Shredded Soaps: Chip soap rolls and dryer machine, soap powder mill and dryer, Duplex soap, powder mixer, soap powder chilling roll machine, carton wrapping and sealing machine.

Toilet Soaps: As remelter, soap chipper machine, cast iron jacketted mixer, amalgamated colour and perfume mixer toilet soap mill, soap plodder machine.

Pressing and Wrapping: Scouring soap press, empire state soap press, special soap stamping press, automatic soap press, soap wrapper machine.

Glycerine Plant: Tanks, catch alls, evaporators filter presses, distilling stills.

Power Plant Machinery: boilers, engines, motors, rotary pumps, centrifugal pumps, evaporators, condensers.

10. METAL WORKING MACHINERY.

Presses: 1. *Gap Frame Presses:* foot press, bench press, inclinable press, open back gap press, end wheel gap press, deep gap punch press, horning press, overhanging press and notching press.

2. *Straight Side Presses:* single and double action press, arch press, double crank straight side press, four point suspension press, and knuckle joint press.

3. *High Speed Press:* straight side high speed press, oscillating disc press, multi-slide double action press, safety bench power press, arbor press and pillar press.

4. *Drawing Presses:* toggle press, hydraulic press, horizontal draw press, multiplunger eyelet machine, rack and pinion deep drawing press.

Hot and Cold Working: * 1. *Forging:* forging press, hammer forge.

2. *Rolling Mills:* (a) blooming mills and slabbing mills; (b) billet mills and sheet bar mills; (c) Plate mills, rail mills and structural shape mills, bar and rod mills, tube mills, wheel and circular shape rolling mills; (d) sheet, tin plate hoop and strip mills and (e) wire drawing mills.

3. *Steel Wire Products:* nail making machines, wire cloth and netting mills, wire rope fabrication mills.

4. *Finishing Mills:* cold rolling and finishing mills.

11. AGRICULTURAL MACHINERY

A. Farming : 1. *Ploughing:* (a) swing plough, one wheel plough, gallows plough, two furrow plough, one way plough, the balance

*Compiled in broad outlines only.

plough and the turnabout or hill side plough : (b) multi-furrow tractor plough, direct coupled tractor plough, deep digging plough, disc plough, and stump jump plough.

2. *Cultivating* : (a) spring tined cultivators, rigid tined cultivator, direct coupled cultivator, very heavy tractor cultivator ; (b) spring tined harrow, chain harrow, self cleaning harrow and disc harrow : (c) the roll, roll pack, the furrow press, the scrubber or planker and the float ; (d) the rotary cultivator and the gyro cultivator.

3. *Seed Planting* : seed drills, root drills, spacing drills, ridge drills press drills, broad casting machine, and potato planters (manual and automatic).

4. *Transplanting* : semi mechanical and fully mechanical transplanter and inter cultivator.

5. *Fertilising* : fertiliser or manure distributor, combined seed and fertiliser drills, mechanical muck and manure loader, farm yard manure distributor.

6. *Harvesting* : (a) trailer mower, direct drive mower, the rake, the side delivery rake, and swath turner, the tedder, the loader, the sweep and stacker, elevator, pick-up baler, ram type baler, and self tying baling press ; (b) silage cutter, the cut lift, the hoser grass pick up, forage crop harvester and chopper, combination silage cutter with blower and tractor.

7. *Reaping, Binding and Thrashing* : (a) the reaper, the binder and the flax pulling machine ; (b) the thrasher ; (c) combination harvester ; (d) potato plough, potato spinner, potato digger, potato harvester, rotary potato sorter, reciprocating potato sorter, sugar beet plough, sugar beet lifter, and sugar beet harvester.

8. *Drainage and Reclamation* : drag line excavator, bucket excavator and trencher, trench excavator or digger, pipe layer, mole plough, bush digger, trench filler and tractor winch.

9. *Pumping and Spraying* : (a) lift pump, force pump, diaphragm pump, semi rotary pump, rotary pump, centrifugal pump, hydraulic ram ; (b) stationary and portable spraying plants, automatic high pressure orchard sprayer, atomising machine, dusting machine, gassing machine.

B. **Barn Machinery** : (a) the winnower, seed dusting machine, chaff cutter machines, root slicing machine, food mixing machine, grass dryer ; (b) plate mills, crushing mills, and hammer mills ; (c) trailer, light railway, portable jib crane, overhead runway elevator and conveyor.

C. **Dairy** : milking machine, cream separator, milk bottling and sealing machine, milk refrigerator and cooler and steriliser.

D. **Power Machinery** : electric motor, vacuum pump, blower and air compressor.

12. OTHER MACHINERY

A. **Boot and Shoe Manufacture** : (Probably to be classed under light engineering industries).

(a) *Templates and Lastings* : 1. Template cutting and grading machines. 2. Last lathes.

(b) *Leather Working* : 1. Drum stuffing ; 2. Leather shaving machine ; 3. Staking machine ; 4. Glazing machine ; 5. Clicking press ; 6. Folding machine ; 7. Perforating or punching machine ; 8. Stretching machine.

(c) *Leather Cutting and Forming* 1. presses, revolution press, double open ended press, non-repeat press, and sole cutting press ; 2. Patent sole rounding machine ; 3. Evenning and grading machine ; 4. Insole lip cutting and scoring machine, insole channelling machine, insole lip turning machine, insole lip setting machine, insole buffing machine, insole flexing machine ; 5. Sole moulder, sole leather splitting machine, sole channelling machine, channel opener ; 6. Stiffner and middle sole skiver, stiffner and toe puf skiver, stiffner crimping machine, double stiffner rolling and waxing machine, stiffner moulding machine, 7. Shank-reducing machine, sole waist skiving machine, welt cutting machine ; 8. Heel builder machine, heel compressing machine, universal slugging machine, heel breasting machine, heel trimming machine, heel flap trimming machine, heel top piece trimming machine, jointing machine, automatic edge setting machine, waist scoring or corrugating machine ; 9. Heavy leather rolling machine ; 10. Dust extraction and air conditioning plant ; 11. Lacing machine ; 12. Rotary pounding up machine ; 13. Taper nail tacking machine, sole sewing machine, outsole rapid lockstitch machine, welt staple stitching machine, sole stitching machine, outsole channelling machine, welt splitting machine, grooving and bevelling machine, welt sewing machine, universal rounding and channelling machine ; 14. Stamping and embossing machine ; 15. Trimming machine, (shoe cleaning machine) ; 16. Last pulling machine.



APPENDIX V

ANCILLARY PRODUCTS NEEDED TO FACILITATE THE MANUFACTURE OF CAPITAL GOODS

Standard machine taps and dies and threaded chasers.
Standard pipe taps and dies and threaded chasers.
Machine drills, Machine Reamers, Machine Mandrels, Machine Arbors, Machine Collets, Machine Punches.
Machined bolts and nuts, studs and screws, solid pins and cotter pins of steel, brass, copper etc.
Milling machine cutters, Gear cutters and hobs.
Plain and carbide tipped cutting tools.
Ball bearings, plain bearings, rollers and roller bearings Oil-less bearings.
Precision cut plain spiral, bevel, cast, steel, brass and bronze gears.
Good commercial cast iron, cast steel, brass, bronze and aluminium castings of plain and alloy metals.
Precision standard gauges of all types, plug screw, snap and slip.
Precision surface plates, angle plates, blocks, beams, squares, straight edges, rulers, vee blocks, etc.
Forgings, drop forged, pressed and hammered.
Stampings in steel, brass, tin, copper, aluminium.
Tubing-butt and lap welded, of steel, brass, copper and other alloys.
Extruded brass, bronze and copper products.
Springs of steel, brass, bronze etc, helical and specials etc.
Deep drawn steel, brass and copper products.
Plastics, moulded parts, from suitable plastic raw materials.
Jigs, fixtures, knurling tools, forming tools, special tools etc. Abrasives and grinding wheels etc.
Rivets of steel, brass, copper and aluminium etc.
Washers of steel, brass, copper and aluminium etc. spring washers.
Bushings of brass, steel, bronze etc. of standard sizes.
Machine tool holders and clamps etc.
Mechanical drive chains, sprockets etc.
Machinists, 'blacksmith, wood working and electricians' handtools.
Valves, cocks and fittings for steam, air, water and chemical fluids etc.—(ferrous as well as non-ferrous).

APPENDIX VI.

DETAILED STATEMENT OF THE SEVERAL UNITS OF MANUFACTURE REQUIRED TO BE ESTABLISHED FOR THE MANUFACTURE OF HEAVY MACHINERY.

Excavating Machinery : Disc harrows, shale planers, shovel and grab bucket excavators, ladder excavators, dragline excavators, tractor and scoop and trench excavator or digger etc.

Hoisting Machinery : Hydraulic and pneumatic power hoists, bridge cranes, jib cranes, pillar cranes, grab bucket cranes, derrick cranes and guy derricks, etc.

Mobile Machinery : Locomotives, tractors, trucks, automobiles and road rollers etc.

Conveying Machinery : The modern chain lehr, aerial ropeways, continuous chain conveyors winches, car pullers, grate and roller conveyors, tray and bucket conveyors, screw conveyors, belt conveyors, endless rope haulage gear, log haulups, cane conveyors and feeders, sugar conveyors, portable conveyors, mono rail conveyors, hydraulic and pneumatic conveyors, hydraulic and power feeders, singeing machines, damping and calendaring machines, push plate feeders, apron feeders, chain feeders etc.

Crushing Machinery : Gyratory crushers, jaw crushers, hammer crushers, disc crushers, roll crushers, chip crushers and rotary crushers etc.

Grinding and Disintegrating Machinery : Pebble and ball mills, tube and rod mills, ring and bowl mills, pan mills, wet grinding pans, edge runner mills, pulp grinders (pocket and magazine type etc.), bale pulpers, breaking pulpers, beaters and refiners and kneading or disintegrating machines etc.

Grading and Screening Machinery : (a) Electric and magnetic separators, gyratory or rocker or vibratory screens, rotary screens, multi-grader screens, chip screens, grate screens, and inclined screens etc. (b) ore dressing machinery clarifiers, sludge thickeners, decanter thickeners, washers, flocculators, sand and gravel filters, pressure filters, suction filters, centrifugals, pulp washers, rag washers, sand catchers, deckers, thickeners, save alls, candle filters, strainers, tank clarifiers, dorr clarifiers, bag filters, cloth filters, bagasse filters, centrifugal subsider, slurry separators, wash mills and cream separators etc. (c) dust extractors and cyclones, bag filters, cell filters, gas scrubbers, gas absorbers and rag dusters etc.

Agitators and Mixers : pneumatic agitators, mixing cyclones, bag filters, cell filters, gas kneading and mixing macseparators, wash mills and cream separators mixers, triple shafted mixing cyclones, bag filters, cell filters, gas

powder mixers, soap powder mixers, amalgamated colour and perfume mixers, and the soap crutcher machines etc.

Bins, Tanks and Storage Vessels : (a) Riveted or welded tanks, chip bins, washers, emulsion mixer tanks, dyeing vats, ripening tanks, dialysing tanks, storage bins, begasse washing tanks, cane juice storage tanks, sulphitation and carbonisation tanks, cane sugar solution tanks, measuring tanks, wagon tanks, churn drums, clarifier tanks, settling tanks, defectation tanks and catch alls etc. (b) *Pressure Vessels* : gas tanks and vessels (cylindrical and spherical); drums, accumulators, receivers. (c) *Special Construction* Chemical storage tanks requiring protective coatings or linings, batch stills, continuous stills, plate towers, fractionating columns, barking drums, sulphite manufacturing coolers and towers, digesters, liquor tanks, diffusers, stock chests, leaching tanks, dissolving tanks, chemical storage tanks, reaction tanks, coolers, rotary kilns, rotary clinker coolers and rotary smelting furnaces etc.

Weighing Proportioning Machinery : Weighing platforms, automatic proportioning weighers, proportioning pumps.

Drying Equipment : Flakers, hot air driers, spray driers, rotary driers, drum driers, tower driers, belt driers, vacuum driers, bark driers, pulp driers, paper driers, drying machines for textile fabrics, sugar driers, carrier driers, tunnel driers, car driers, wool driers and proctor driers etc.

Pressing Machinery : (a) Hydraulic presses, moulding presses, bark presses, filter presses and lappers, paper presses, smoothing rolls, sizing presses, bale presses (cotton, jute and cloth), brick and tile presses, (lever press, toggle press), dry brick making presses, brick and tile represses, (screw press, hand and power press), hand operated and power driven slabbing presses, scouring soap presses, automatic soap presses, soap stamping presses, other pressing machines ; (b) gap frame presses, straight side presses, high speed presses, drawing presses, forging presses, high drop forge presses and represses etc ; (c) pug mills, brick moulding machines, (plastic and semi-plastic clays).

Extrusion, rolling and drawing machinery : Shredding machines with plain or grooved or toothed or spiked rolls, clay cleaners, cane multi-roller crushing mills, remilling machines, roller gins and saw gins, rolling mills (blooming mills, slabbing mills, billet mills, sheet bar mills, plate mills, rail mills, structural shape mills, bar and rod mills, tube mills, sheet, tin plate, hoop-and-strip mills and wire drawing mills etc.), cold rolling and finishing mills.

Bleaching, Boiling and Washing Machinery : Bleachers (high and low pressures), multi-stage bleachers, lime or soda boilers, washers, driers, mercerizers, wool steeping machines, wool scouring machines, dyeing machines. Desulpherising, bleaching, souring and washing machines, bleachers, bleaching towers, washers, boiling and washing drums etc.

Propelling and Pumping Machines : Reciprocating pumps, rotary pumps, centrifugal pumps, centrifugal fans and blowers, air

lifts, squeeze pumps, hydraulic or pneumatic or steam ejectors, vacuum pumps, hydraulic pumps and slurry pumps etc.

Heat Exchangers : (a) condensers, evaporators, heaters, coolers, vacuum pans, crystallisers, kettles with heating or refrigerating coils, electric heaters, spray ponds and cooling towers, steam vapour refrigerators, other vapour refrigerators, humidification and dehumidification plant and equipment, steam accumulators, deaerators, air conditioning and ventilating plants ; (b) boilers, economisers, air heaters, gas producers, superheaters, pot furnaces, tank furnaces and annealing furnaces etc.

Prime Movers and Tractors : steam engines, gas engines, oil engines (semi diesel and diesel), petrol engines, paraffin engines, reciprocating compressors, steam turbines, gas turbines, tractor engines, motors, generators and alternators etc.

Cutting and Shredding Machinery : cup-up mills, slashers, chippers, knife barkers, rag cutters, slitters, cutters and winders, shearing machines, cropping and cutting machines, cane cutters, cane shredders, brick and tile wire cutting tables, trimming machines and soap chippers etc.

Special Machinery (Unclassified) Fourdrinier paper machines (flow boxes, slices, deckle, forming part, pressure part, dryer and shakes rolls etc.), calenders, reels, rewinder machines, layboys, super calenders, sheet calenders etc., plaiting machines ruling, colouring, coating and glazing machines, textile printing machines, automatic cement packing machines, plate glass rolling machines, and sheet forming and drawing machines, glass tube and rod drawing machines, the bog feeder machines, the automatic bottle making machines, mould pressing and blowing machines, the Corning bulb machines, the continuous glass fibre drawing machines, the flame cracking and polishing machines, the glass grinding polishing and trimming machines and the glass frosting machines etc.



TABLE I—A

INDUSTRIAL PLANT AND MACHINERY (HEAVY)

Statement showing the imports for other Mill Plant and Machinery for the periods 1935 to 1945

(Values in Thousands of Rupees)

Item of Plant and Machinery	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44	1944-45
Boot and Shoe Mfg. Machinery ...	453	480	447	459	223	142	139	175	175	299
Leather Tanning and Curing Machinery ...	92	127	184	55	106	119	75	42	117	123
Acrated Water Making Machinery ...	35	36	37	35	22	9	7	5	2	...
Mining Machinery (Total)	4,122	7,354	1,693	2,516	4,845	3,132	1,802	2,735	2,459	7,681
(a) Seal Mining Machinery ...	217	208	649	1,105	626	675	395	97	120	...
(b) Other Mining Machinery ...	3,905	7,146	1,044	1,411	4,219	2,457	1,407	2,638	2,339	...
Oil crushing and Refining Machinery ...	2,177	2,660	2,880	4,419	2,887	1,433	675	304	346	373
Paper Mill Machinery ...	866	785	4,489	2,767	1,336	3,108	3,109	1,499	2,514	2,500
Rice and Flour Mill Machinery ...	936	800	885	685	570	469	379	159	330	304
(a) Flour Mill Machinery ...	...	...	...	444	361	197	174	101	218	180
(b) Rice Mill Machinery ...	...	...	...	241	209	272	205	58	112	124
Saw Mill and Wood Working Machinery ...	522	452	413	409	427	654	1,514	1,127	996	1,669
Sugar Mill Machinery ...	6,572	9,516	6,938	6,137	5,384	4,087	2,042	773	320	1,108
Tea Machinery ...	1,263	1,477	2,097	2,203	1,721	1,620	1,140	1,249	2,202	4,213
Metal Working Machinery ...	...	...	...	...	...	...	...	...	...	...
(a) Machine Tools ...	1,827	3,318	3,043	3,067	4,431	5,638	6,030	4,739	2,849	14,389
(b) Other Kinds ...	...	655	569	323	567	386	812	959	2,518	901
Printing and Lithography Presses ...	1,668	1,822	2,305	1,859	1,734	488	2,153	176	40	376
Agricultural Machinery (Total)	966	1,203	1,079	1,396	1,869	2,349	2,965	794	221	961
(a) Agricultural Tractors (Not including power units)	474	614	511	735	1,399	1,886	2,619	691	96	817
(b) Plough and Parts ...	110	200	130	131	321	177	172	33	14	32
(c) Other Sorts ...	381	389	438	530	250	285	165	70	112	113
Unclassified	25,076	22,541	29,892	45,541	31,434	24,718	25,539	19,212	18,376	29,871

TABLE I—B

INDUSTRIAL PLANT AND MACHINERY (HEAVY)

Statement showing the imports for Mill Plant and Machinery for the periods 1935 to 1945 corrected to 1935-36 cost basis (Value in Thousands of Rupees).

Item of Plant and Machinery	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44	1944-45
Boot and Shoe Mfg. Machinery ...	453	453	347	333	171	90	77	96	96	165
Leather Tanning and Curing ...	92	120	142	39	81	75	42	23	65	68
Mining Machinery Total ...	4,122	694	1310	182	370	198	100	151	136	422
Oil Crushing and Refining ...	2177	2600	1770	3500	2200	908	374	168	191	206
Paper Mill Machinery ...	806	740	3480	2000	1020	1970	1730	628	1385	1375
Rice and Flour Mill ...	936	756	680	497	435	297	210	88	183	167
Saw Mill and Wood Working ...	522	427	320	296	326	414	833	622	512	918
Sugar Mill ...	6,572	8980	5380	4440	3890	2600	1130	428	453	608
Tea Machinery ...	1,263	1390	1620	1640	1320	1030	629	690	1220	2320
Metal Working Machinery not included										
Machine Tools ...	1827	617	441	599	433	245	450	530	1390	380
Printing and Lithography Presses ...	1668	1720	1790	1349	1340	310	1190	97	22	207
Agricultural Tractors (Not including power units)	474	579	396	540	1070	1200	1470	382	53	449
Ploughs and Parts ...	110	189	100	95	169	102	95	18	8	18
Other Sorts ...	381	367	340	384	191	181	91	39	62	62
Unclassified ...	25,067	21250	23200	33000	28000	15700	14100	10600	10200	16500
Cost Index figure (Iron and Steel) ...	100	106	129	138	131	158	180	181	181	182

TABLE I—C

INDUSTRIAL PLANT AND MACHINERY (HEAVY)

Statement showing the imports for Textile Plant and Machinery for the periods 1935 to 1945

(Value in Thousands of Rupees)

Item of Plant and Machinery	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44	1944-45
1. Textile Plant and Machinery Total	34,195	27,594	45,049	37,877	26,879	22,677	28,422	27,734	31,928	33,786
(a) Total of Cotton Textile Plant and Machinery	20,035	18,073	29,213	26,686	19,645	13,686	18,084	18,300	24,040	22,606
Details : 1. Spinning Machinery	10,848	9,505	16,128	12,680	10,773	7,464	9,298	10,562	13,713	12,886
2. Weaving Machinery	5,688	5,470	7,576	7,661	5,135	4,048	5,747	5,854	8,294	6,787
3. Printing Machinery	151	147	578	575	565	376	495	210	98	129
4. Bleaching and Dyeing Machinery	631	577	485	692	477	152	335	159	136	82
5. Other sorts of Machinery	2,716	2,373	4,444	5,079	2,675	1,646	2,508	1,516	1,799	2,812
(b) Jute Textile Machinery	11,543	7,398	10,615	7,094	4,592	6,104	5,691	3,476	2,448	5,330
(c) Wool Textile Machinery	372	282	297	194	257	258	716	330	682	469
(d) Other Textile Machinery	1,547	1,215	4,036	3,067	1,435	1,063	1,588	3,237	1,560	2,194
(e) Textile Plant Shutles	698	576	888	837	951	1,466	2,344	2,390	3,198	2,896
(f) Textile Plant Bobbins	3,103	2,244	4,274	3,792	3,789	4,790	6,493	5,654	6,616	8,111

TABLE I-D

INDUSTRIAL PLANT AND MACHINERY (HEAVY)

Statement showing the imports for Plant and Machinery for the period 1935 to 1945 corrected to 1935-36 cost basis
(Value in Thousands of Rupees)

Item of Plant and Machinery	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44	1944-45
Cotton Textile Plant and Machinery										
Details :-										
1. Spinning Machinery ...	10,850	8,980	12,500	8,180	8,210	4,730	5,170	5,830	7,580	7,070
2. Weaving Machinery ...	5,790	5,150	5,880	5,550	3,040	2,560	3,190	3,240	4,590	3,730
3. Printing Machinery ...	151	138	449	417	432	238	276	116	54	71
4. Bleaching and Dyeing ...	631	545	384	502	364	96	20	88	75	45
5. Other sorts ...	2,716	2,235	3,440	3,680	2,040	1,040	1,390	838	994	1,540
Jute Textile Machinery	11,543	6,970	8,250	5,140	3,510	3,870	3,160	1,920	1,350	3,040
Wool Textile Machinery	372	266	231	141	196	164	398	182	378	258
Other Textile Machinery	1,547	1,145	3,140	2,220	1,100	672	881	1,790	862	1,210
Textile Plant Shuttles ...	698	534	639	606	727	927	1,300	1,320	1,770	1,590
Textile Plant Bobbins ...	3,103	2,180	3,660	3,220	3,240	3,400	4,160	3,540	4,050	4,840
Cost Index figure (Iron and Steel)...	100	106	129	138	131	158	180	181	181	182
Cost Index figure (Manufactured articles) ...	100	103	117	118	117	141	156	160	163	168

TABLE II**Pre-war Period Demand of Categories of Industrial Plant and Machinery
(Heavy) (Estimated)**

					Values in Lakhs of rupees at 1935-36 Index
1.	Excavating Machinery	...	...	...	18
2.	Hoisting Machinery	...	...	...	22
4.	Conveying Machinery	...	...	...	24
5.	Crushing Machinery	...	...	...	29
6.	Grinding and Disintegrating Machinery	...	...	...	23
7.	Grading and Screening Machinery	...	...	...	29
8.	Agitators and Mixers	...	...	...	12
9.	Tanks and Storage Vessels	...	...	...	36
10.	Weighing and Proportioning Machinery	...	...	...	9
11.	Drying Equipment	...	...	...	14
12.	Pressing Machinery	...	...	...	23
13.	Extrusion, Rolling and Drawing Machinery	...	...	No Estimate	
14.	Bleaching, Boiling and Washing Machinery	...	...	...	20
19.	Cutting and Shredding Machinery	...	...	...	14
20.	Textile Machinery (Preparation Machinery)	...	...	...	45
21.	Textile Machinery (Spinning)	...	...	...	140
22.	Textile Machinery (Weaving)	...	...	...	84
22. (a)	Textile Shuttles	...	...	...	7
22. (b)	Textile Bobbins	...	...	...	31
25.	Agricultural Machinery (Not including Power Units)	...	...	...	11